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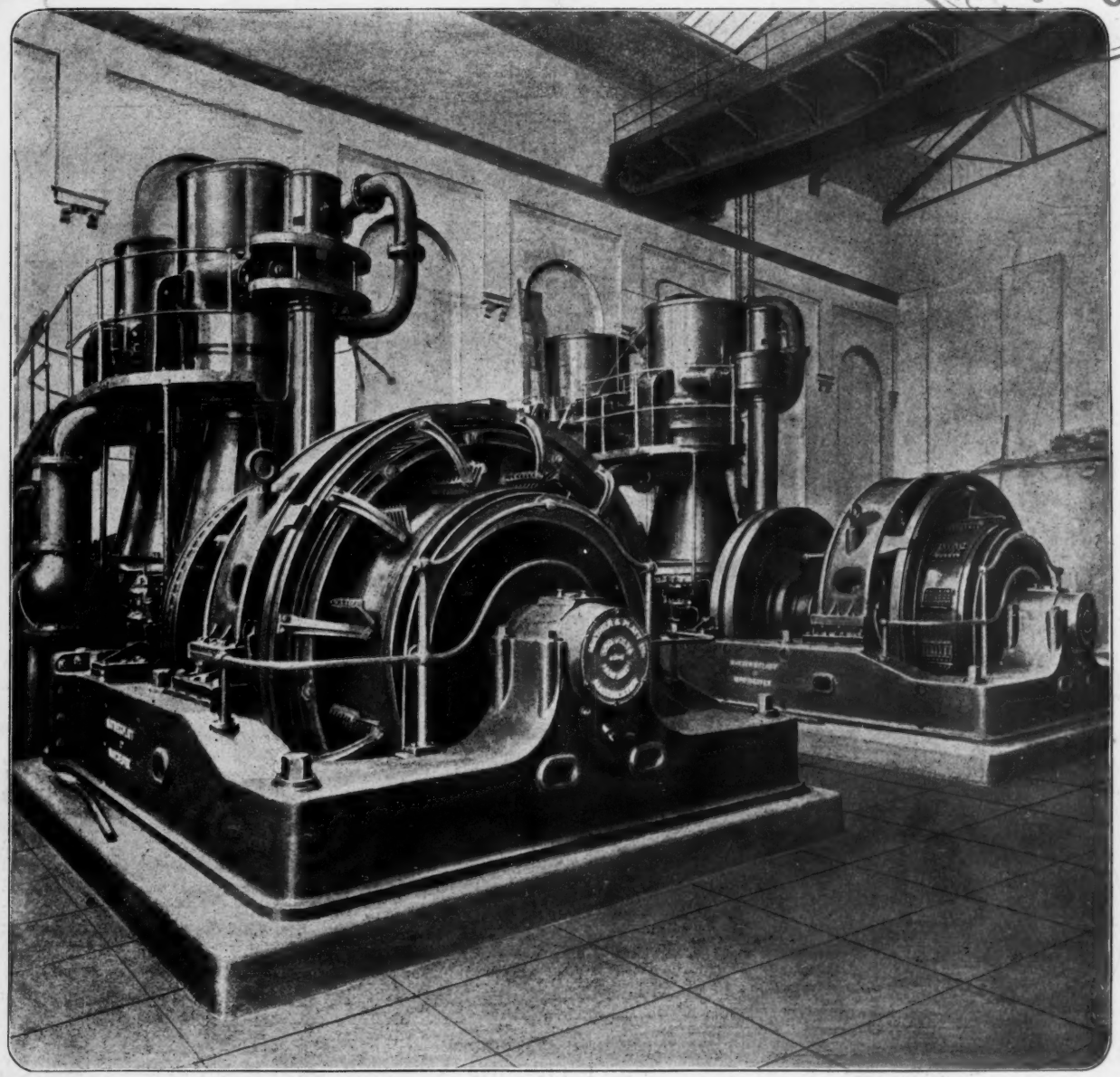

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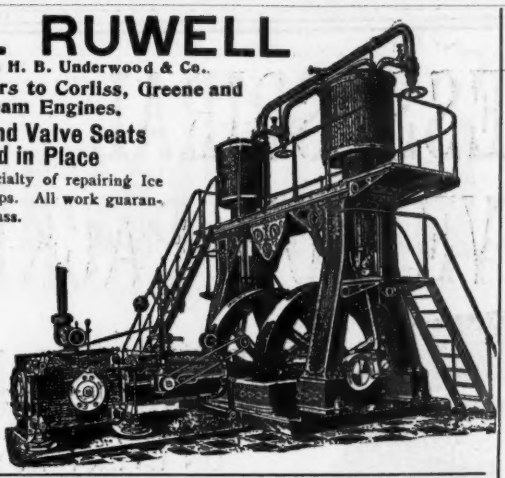

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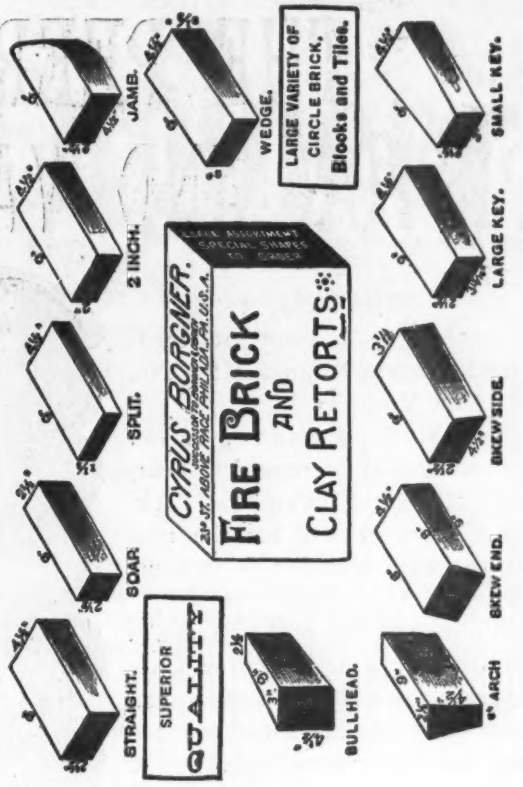

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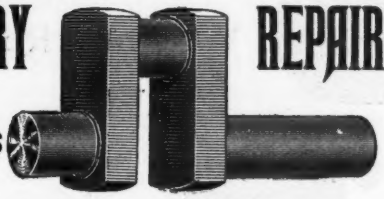

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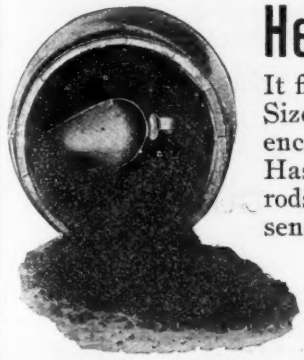

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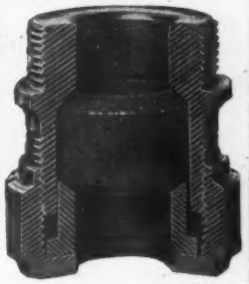

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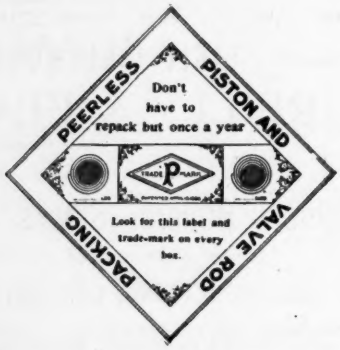

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VOL. VII PHILADELPHIA, JULY, 1903 No. 6

Electromotive Force.

BY A. G. WILLIAMS.

In this article I will endeavor to explain some of the great natural laws and their effects, as due to, and governed by the Electromagnetic law of rotation as established by ampere.

Electricity is either latent or free, when it is latent, we term it magnetism. When free it exerts eletromotive force.

To produce Electromotive force from a magnet, we must apply some outside energy, such as manual, atmospheric, hydraulic, or steam, to move a coil of wire surrounding an iron core in the magnetic field. These forms of energy are dependent upon combustion in one form or another.

The voltaic battery evolves heat also by combustion or chemical decomposition, and none of the above so-called generators evolve one particle of electricity, combustion and decomposition can only produce heat.

All bodies contain electricity more or less according to their capacity, and in this state they are perforce more or less magnetic or possess the property of cohesion.

All particles of matter evidence this attraction of cohesion. The gases composing our atmosphere are held together as a mechanical mixture by their different electrostatic capacities.

Water is governed by the same law. Metals, stones, etc in fact all material things are held together by attraction of cohesion and may be looked upon as magnetically united.

To destroy their power of cohesion heat must be applied. Therefore to separate their bond of union or latent state, force must be used which means an expenditure of heat.

The ether, in which our globe floats as a mere speck amongst countless other globes, is in every way a limitless ocean of latent electricity in other words an infinite magnetic field.

We are now realizing that there is a great preponderating force which governs the universe, and is the cause of our earths rotation, and the same force actuates the suns motion.

Within the past century the study of Light and other forms of radiant energy has furnished suggestive object lessons.

The luminiferous ether combines properties which are almost beyond our conception.

Electromagnetic force is the only power we can conceive capable of fulfilling the conditions necessary for universal motion which produces heat by friction against space or a magnetic field. The whole of space is loaded with energy, so abundant is it, that every cubic inch of it contains an equivalent of not less than 500 horsepower, each cubic foot more than all the full working steam engines of Massachusetts.—(Professor Dolbear).

This energy is further described as residing in the ether and cut out of it come all the forms of energy we know of and employ. Gravity heat, light, electricity, etc.

Can we not recognize the ether as a vast and unlimited ocean of latent or stationary E. M. F. from which matter by resistance cuts out energy exactly as a dynamo cuts out E. M. F. from the air-gap in the magnetic field.

The energy of the ether is exerted upon all material bodies as a compression force,. Its extreme low temperature contracting and tending towards their solidification, but in the process, it is resisted by the inertia of matter, heat is the result. The suns temperature has been calculated 28000 Fahr, can we not suppose that the ether temperature is 28000 degrees below zero. If so we can grasp the idea of an enormous store of energy residing in the ether as a compressive force resisted by the expansive force of matter in motion.

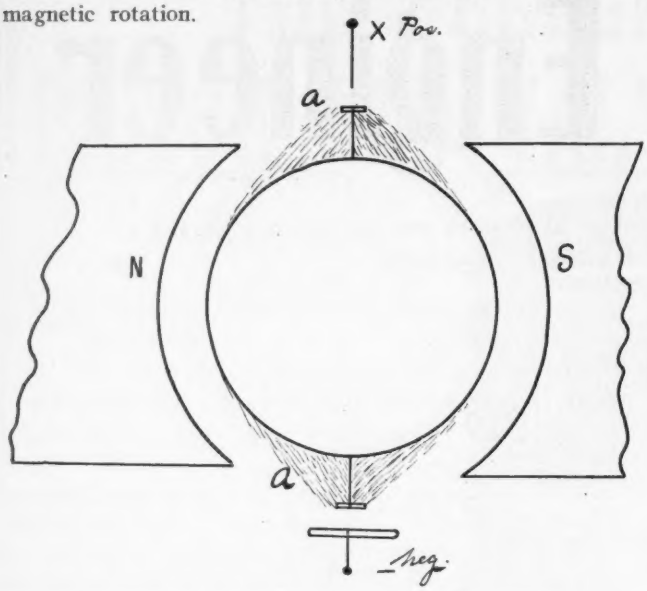
The range of temperature in space is as varied as that of matter. Matter affects the temperature of space by its abundance or absence. Clouds of fiery incandescent material sweep through its depths; in other regions an empty black void of an exceedingly low temperature. Thus the ether potential is never the same in any part. It is as restless as our atmosphere, showers of asteroids, meteors, clouds of vaporous nebulae, suns and planets float in its midst. Our atmosphere is a miniature of the ether and to which it can be compared. It also contains an enormous energy which man utilizes in windmills and sailing ships.

The ether supplies the force which causes the earth to turn round on its axis every day with a velocity of 1000 miles per hour.

Our globe is poised between two planes of different temperatures, occupies a weakened interspace caused by the suns enormous centrifugal energy, to restore this balance a tremendous stream of electricity pours upon the south pole as a brush shaped charge, the atmosphere carries this charge to the North Pole where it escapes to outer space, in the form of Aurora Borealis.

The solid earth is thus an electromagnetic engine suspended between two planes of different electrostatic ether and which

in their struggle to restore an equilibrium in the interplanetary weakened space or vacunm, the globe forms the path of least resistance and rotates in accordance with the law of electromagnetic rotation.



To illustrate this I will quote the following experiment. Fig. 1. (Deschanel's Natural Philosophy.) The Electric Egg.

Action of magnets on currents in rarefied gases. The luminous discharges in Geisslers tubes are like the voltaic arc veritable magnets. They are capable of deflecting a magnetized needle, and are themselves acted upon by magnets as in the following:—"A soft iron rod is fitted in the interior of a glass vessel from which air can be exhausted, and is coated with an insulating substance to prevent discharge between it and a metallic ring, which surronds it at its lower end. When the terminals of a battery are connected with this ring and the with the upper end of the apparatus a luminous sheaf extends from the summit a towards the wire ring B, and surronds the soft iron rod.

If while things are in this condition, we place beneath the apparatus one pole of a permanent or electromagnet, the soft iron rod is magnetized and the luminous sheaf immediately begins to revolve round it, the direction of rotation always being in accordance with amperes law of electromagnetic rotation.

Under above conditions the rotation will be from west to east.

The luminous sheaf is an illustration of the auroral charge and discharge at the earths poles. Were the iron rod free to revolve it would also rotate.

Fig 2:—A spheroidal metallic shell pivoted at A, and B, N, and S, the poles of a powerful magnet, the globe coated with shellac so as to prevent sparking,. A powerful discharge is exerted from the summit to the lower end of this globe through the magnetic field. The globe, under these conditions will revolve, exactly as the above quoted luminous sheaf.

This electric motor rotates in magnetic space in exact accordance with the law of electromagnetic rotation, and in the same manner the earths electromagnetic rotation is developed by its magnetism or latent energy, and inertia resisting the free electromotive force of the ether.

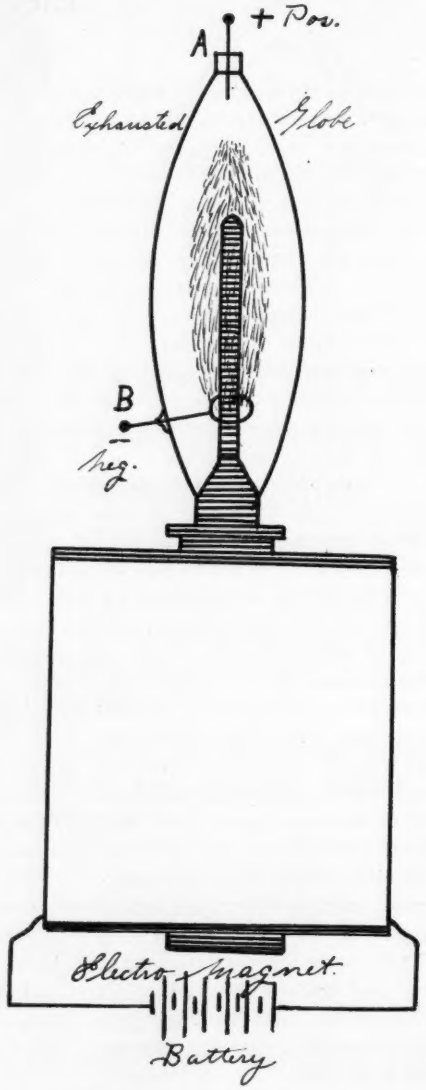
The globe takes the place of the armature; the lines of magnetic force which are denoted by the magnetic needle pointing to the poles, the winding wires, the atmosphere, the interspace between the armature and the stationary magnets.

The ether the permanent but ever pulsating electromotive force, exactly fulfilling all the conditions of an alternating multiphase current machine.

The magnetic needle, deflected by the meridianial line or electrical current passing directly under it from pole to pole responds to every thermal fluctuation caused by internal or external means.

The universe is, thus, in wireless communication, the needle responds to every pulsation from the suns mass, suns spots violently agitating it. The aurorae are the antennae or collecting and distributing network of wires.

Wireless telegraphy has successfully bridged over thousands of miles of the earths surface what must be the electromotive force of the universe which covers millions upon millions of miles of space practically in an instant a disturbance in the suns mass jumps over 93,000,000 miles in a very short time.



The Aurorae Borealis and australis glow with greater brilliancy, the earths E. M. F. increases, the network of telgraph wires and cables are immediately disturbed, the magnetic apparatus and needles respond. Truly the mariners compass is a celestial dynamometer of the universal electromotive force.

The Products of Petroleum

By T. H. Reardon.

The petroleum products that are of direct importance in engineering, are crude oil, used so extensively as fuel; gasoline, largely used in gas engines, and the heavy oils that distil at a relatively high temperature, and form the basis of mineral lubricants. While the three products enumerated above may be said to be the only one's, that directly engage the attention of the engineer, still an account of several other products that are obtained at the same time will prove interesting.

The oil wells of Pennsylvania evolve large quantities of a gaseous mixture, consisting of free hydrogen H, methane CH_4, and ethane C_2. H_6. this mixture constituting what is known as natural gas, and it is used quite extensively for heating and illuminating in the surrounding districts.

The crude oil as pumped from the wells still contains quite a considerable amount of gaseous matter, notably ethane, propane, and butane. These highly volatile products are collected, and subjected to the action of a condensing pump and by means of a cooling effect and pressure, a portion of them are liquified, yielding the first liquid product, an article known as cymogene, having a specific gravity of .59, and it is used to some extent in freezing machines, as its rapid evaporation produces great cold.

It should be remarked here that the various products are separated from each other by the process known as fractional distillation, which depends on the difference in their boiling points; when a certain definite temperature fails to cause any further distillation, the temperature is increased a certain amount, and as much of the petroleum as distils at this temperature is collected as the next product, when the temperature is advanced again for the distillation of the product having the next higher boiling point.

After the collection of cymogene, the next product passing over is rhigolene, having a specific gravity of .62 and a boiling point of 64° F. , it finds employment in the arts as a standard of light and in medical circles as an anesthetic.

The next product that distils at about 140° is commercially known as petroleum ether, petroleum spirits, or gasoline. It has a Specific Gravity of .66 and it is used in many indusies as a solvent for india rubber, etc. Of late however is has acquired great importance as a source of power in gasoline engines. The next product is variously known as naphtha ligroin, or benzoline, it is collected until the temperature rises to 230°, it is used as a burning oil in some kinds of lamps, and in manufacturing processes as a solvent.

The Specific Gravity is about .70.

The next product is known as benzine and should not be confounded with benzene the coal tar product as it is an entirely different article. It is collected below 302°, has a specific gravity of .74 and posesses the same inflammable, and solvent properties as the other volatile products of petroleum.

Kerosene oil, so generally used for lighting, distils at the next higher temperature, and the distillation is conducted affording oils of different densities, and boiling points, until the point is reached at which the heavy lubricating oils are collected; The distillation is carried on until a tarry residue remains in the retort. The distillate above 572° contains heavy lubricating oils, and paraffin wax; the wax is easily seperated as it solidifies at the ordinary temperature of the air.

As appears from the foregoing, lubricating oil is obtained by removing the lighter hydrocarbons from the crude petroleum by the process of fraction distillation; sometimes the product intended for lubricating oil is collected as a distillate, and again by a different process, it is purified by filtration through animal charcoal, the distillation being omitted.

Oils of all kinds, are as a rule agitated with sulphuric acid, in the purifying process; besides deodorizing, and destroying the fluoresence of an oil, the acid combines with many impurities, which settle to the bottom of the purifying tanks and are in this way removed. The oil is treated with soda after the acid treatment, this serving to remove any free acid.

The superiority of mineral oils over animal oils, resides in their greater stability in resisting chemical changes, which in animal and vegetable oils are easily induced by either temperature or chemical reagents.

The composition of an animal or vegetable oil is analogous to the composition of a mineral salt- that is it is made up of an organic fatty acid, that is neutralized by a hydrocarbon radical, just as a mineral acid is neutralized by a metal. As compounds of this class are very unstable, they are easily decomposed, or broken up, and in all such cases the acid which in combination was harmless, is set free and is seeking new combinations. With mineral oil the case is entirely different, nothing other than highly concentrated chemical reagents will attack mineral oils, and then the physical change produced is not very great; paraffin, which is representative of the stability of petroleum products, unless heated resists the reaction of all chemical reagents, even when concentrated.

With the high temperature of the present, resulting from high pressure steam, there is nothing that can take the place of high grade mineral oil for the lubrication of steam cylinders, and the refinining of oil has reached such a high standard of perfection, that there is absolutely no difficulty in supplying a first class article to any one that is willing to pay a good price.

The Training of the High Tension Engineer

A paper by P. M. Lincoln, of the Westinghouse Electric and Manufacturing Co.

There are two schools in which the electrical engineer may receive his training, but only one in which he must receive a course before he can be called a high tension engineer. Those things which are learned in the schools equipped with professors and laboratories and mathematical text books must be supplemented by the things which can be learned only in the school of experience. These two schools are quite different in method. The college instructs in theory and in those methods of doing things which have become standard by universal adoption. The college teaches positive knowledge. In the school of experience, on the other hand, one is more apt to learn how not to do it, and by the elimination of the unsuccessful, arrives at the goal of success. The knowledge gained by experience is more often negative.

Put to the fresh college graduate the problem of the amount of distance to be left between the conductors of the high tension transmission line. His answer will involve most likely the jumping distance of the voltage to be used, the length of span, the sag and perhaps a liberal factor of safety. It is experience only that will show that his premises are wrong and that the equation to determine spacing of high tension wires depends very little on the voltages to be carried and almost entirely on such things as the average length and ohmic resistance of cats, the spread of wing of owls and cranes and eagles, and the

average length of scrap baling wire, together with the strength of the average small boy's throwing arm.

The college graduate enters practical work invariably feeling that the greatest danger of his work lies in his liability of receiving a shock from the high tension conductors. Not until he has had experience with accidents of an electrical nature does he learn that it is the danger of being burned that he has to fear more than the danger of shock. My own experience, and I think it will be checked by the large majority of those in a position to know, has been that the number of electrical accidents in which the victim has been injured by burning is incomparably greater than the number from shock.

The graduate has learned how to make accurate measurements of power. He finds after he has been "up against it" that it is easier to measure power accurately than it is to persuade the customer that his power is being accurately measured.

The man fresh from the college laboratory enters his practical duties with the idea that rubber is one of the best insulators that exists. It is not until he has seen rubber insulation break down in the most unaccountable manner that he finds that rubber as a high tension insulator is extremely treacherous. The deterioration of rubber insulation is probably due to chemical reactions on the rubber induced by the brush discharges, which are in turn caused by the high voltage of the conductor.

The newly made graduate usually has a high opinion of efficiency and can calculate the economy of a transmission to an excessively small fraction. When he becomes responsible for the operation of a transmission line, however, it does not take him long to find out that efficiency is a vanishing quantity when compared to continuity of operation, and that economy is not to be considered as being in the same class as good service.

The technical graduate, in short, may have knowledge a plenty but his wisdom is to come.

It is furthest from my thoughts to cast any slur upon the technical graduate. I look back upon my own course in Electrical Engineering and feel that it is the most valuable asset I ever possessed. The technical course is the best of foundations, but it is only a foundation. The end of the college course is rightly called "Commencement." The great advantage of the technical education is that it gives the man proper equipment for overcoming the difficulties with which his experience is bound to bring him into contact. It gives him, as nothing else will, the power of initiative-that most valuable quality that a high tension engineer can possess. There is nothing like the college education to equip a man for making every accident a lesson in "how not to do it," and every failure a stepping stone to success.

Take, for instance, the recent accident to the Niagara plant, in which a fire destroyed the cables on the bridge connecting the power house with the transformer house. The lesson to be drawn from this accident—so plain that he who runs may read—is that where many cables are run together, extreme precaution should be taken to protect against danger of fire. Before the occurance of this fire there was little suspicion that the insulation of cables when lead covered or protected by fire proof braid—as was the case at Niagara—is sufficient to maintain so fierce a blaze without the aid of some other combustible beside the insulation. One accident of this kind should suffice, not only for the Niagara Falls people, but also for any others who have occasion to run many cables together.

The art of long distance electric transmission as it exists to-day is the result of the accumulated experience of all those who have had to do with transmission work. And the process of accumulation is still going on. Those men who to-day are designing and operating transmission plants are the moulders of the art. There expedients for improving service or reliability or for cheapening cost are noted, and when successful have their influence on future installations.

The experiences of to-day are incorporated into the text books of to-morrow. But, although the result of experience may be taught to the college student—allowing always for a considerable angle of lag—the college curriculum can never become the substitute for the school of experience.

The high tension engineer no less than the man in any other department of human endeavor may find in failure the way to better things. It was Roosevelt, the strenuous, who gave expression to the sentiment that absence of failure accompanied only lack of effort. "The uses of adversity are sweet" and the engineer may well heed the words that Shakespeare puts into the mouth of the Duke, who, exiled to the forest of Arden, finds "tongues in trees, books in running brooks, sermons in stones, and good in everything."

Steam Boiler Explosions.

No general cause can be cited for steam boiler explosions; but a careful analysis of all the facts will generally enable the experienced engineer to arrive at a probable cause, in nearly every instance.

Low water is rarely the cause of an explosion, except in firebox boilers, where the crown of the furnace (which is subjected to the highest temperature) is uncovered and crushed in. But in boilers fired under the shell, with return tubes or flues, it is extremely doubtful if low water is ever the cause of an explosion.

Low water, when it is sufficiently low to permit overheating of the plates below the fire line, may, and in many cases does, contribute to weaken the boiler. When the expansion is in excess of the thermo-elastic limit of the iron, a permanent set occurs, and the iron is in precisely the same condition as though the limit of elasticty had been exceeded by overstrain.

Initial strain is more frequently the cause of explosion than is generally supposed. Many boilers, made of good iron, are put together in such a haphazard and reckless manner that the factor of safety with which they are worked, instead of being 5 or 6, may be but a trifle in excess of the working pressure. A boiler of this kind, after suffering the deterioration due to a limited use, is liable to rupture at, or even below, the working pressure, and occasionally they let go in the shop under trial.

Over pressure—this was Mr. Fairbairn's theory of explosion; but instances have been noted where violent explosions have occurred at less than the working pressure; and with the usual pressure and safety-valve blowing, boilers have let go. Over pressure, however, in connection with excessive initial stain is a fruitful source of disater in the use of steam boilers. Defective steam-gauges, although a trifling detail in themselves, have contributed to ruptures and explosions by false indications. Safety valves are generally set to blow by the steam-gauge, and when this is an unreliable device (which is the rule rather than the exception), then the safety valve becomes a delusion.

Explosions sometimes happen when boilers, filled with comparatively cold water and cold themselves, are incautiously fired.

When the regime of a steam boiler is fully established, all parts of the shell and flues or tubes are practically at the same

temperature, and forcing the first is less liable to work injury; but when a boiler is filled with cold water, and fires are started after an interim of idleness, the rapid firing has the effect of subjecting the bottom of the boiler to an expansion corresponding to the levation of temperature, while the top of the boiler is yet cold. The strains, by reason of the extra expansion of the bottom of the boiler, may be, and in some cases are, sufficient to produce incipient fractures of plates or joints, and place the boiler in condition for a violent explosion, at less than the working pressure.

Overheating of the iron and water is no doubt responsible for certain explosions. So long, however, as the water is in contact with the plate, it is difficult to produce an overheat of the iron; but when the water is repelled or "lifted" from the plate, an instant of time is sufficient to produce a dangerous overheat in the courses nearest the fire. This overheat not only subjects the boiler to the strains of excessive expansion, but materially reduces the cohesive strength of the iron, in addition to which proportionally large evaporation takes place when the water returns to the plates.

It is well known that when the water is deprived of air, it can be elevated to a temperature higher than the boiling-point before vaporization occurs. MM. Donney and Magnus have made experiments on ebullition under the pressure of the atmosphere, and the former found that by carefully freeing the water of air, he could elevate the temperature to 275 degrees Fahr., before vaporization occurred, and when it did occur, the action was not like ordinary ebullition under pressure of the atmosphere, but was instantaneous and explosive, a portion of the water being violently projected from the test tube.

The temperature (275 F.) corresponds to a pressure of about three atmospheres, and M. Donney concludes that this pressure is equivalent to the natural force of cohesion of the particles of water.

How far the results obtained by Donney and Magnus may be used to solve the problem of steam boiler explosions is not known. But there can be no doubt that similar and instantaneous evaporation often takes place in a steam boiler, and whether the effect is to produce a rupture, simply depends upon the strength of boiler and quantity of water acted upon.

The theory of repulsion, so ably argued by Mr. Robinson, is perhaps the most plausaible for those explosions with the usual level of water in the boiler and every indication that no danger exists. Experience has shown that when the iron of a boiler, otherwise clean, is heated to a temperature of 380 to 420 degrees Fahr., the water is repelled from the plate, and under this condition the iron of the boiler may be heated to the temperature of the impinging hot gas. Whenever the equilibrium within the boiler is destroyed, the water returns to the hot plates, and a large and instantaneous evaporation occures. This, instead of naturally passing through the superincumbent water, carries the water with it, and projects it against the bounding surfaces of the boiler. If the mechanical effect of this percussive action be sufficient to produce a rupture, then there is an immediate reduction of pressure, followed by a further and larger evaporation, which, in seeking to escape, rushes through the vent with a velocity proportional to the unbalanced pressure, and carries the now dismembered boiler with it, upon the same principle that a mountaiu torrent can convey large rocks for great distances, and a whirl wind carry for miles, bodies of matter having a greater specific gravity than the air.

Engineers are generally united in the opinion that the most disastrous explosions are those occurring with boilers carrying the usual level of water, and that the violence of the explosion is directly proportional to the weight of water in the boiler at time of rupture.

Corrosion, internal scale and deposits, improper setting impeded circulation, and improper steam and water connections between batteries of boilers, have each contributed to swell the list of explosions.

The Result of Small Leaks

It is well known that steam engines at the best utilize but a small proportion of heat supplied them in the nature of steam, the major portion going to waste. This waste feature is, however, unavoidable under present conditions.

The "second law" of the mechanical theory of heat teaches us that in a heat motor working on any such principle as that of the steam engine it is theoretically impossible to utilize, in the production of mechanical work, more than a certain fraction of the heat that is supplied. This theoretical efficiency can be easily calculated for any given steam plant, and it is a source of considerable satisfaction to note that the performance of the best modern engines comes within a reasonable distance of this theoretical possibility.

A good deal of the heat is lost at the boiler, some 20 persent or more going up the stack instead of being absorbed by the heating surfaces of the boiler. This loss is also to a large extent unavoidable. That is, there will be a considerable loss of this nature, no matter how well designed and constructed the boiler ma be. Loss from this cause must therefore be placed in the same class with heat indicated in the foregoing paragraph. These two are indeed losses, but they are not wastes; a wast being defined as a loss that can be avoided by proper management.

Some years ago it was thought proper to run engines with considerable black pressure, so as to produce a distanct puff puffing from the exhaust pipe, and in some cases this is still done, but not by our best engifieers. One of the heat wasts that is neglected more than it ought to be is radiation from steam piping, or from the boilers themselves. Careful test made some years ago gave results that may be studied with profit by any engineer who has naked pipes under his charge. Three tests were made, each ten hours long, and all precautions were taken to insure that the external conditions should be the same throughout.

The average temperature of the air surronding the pipe was 70°, and was the same, within a degree or so, in all three tests. Steam was the first blown through the pipe until both the pepe and the receiver attached to it were throughly heated up and free from water. The pipe was then left to itself with steam turned on for ten hours, after which the water of condensation was collected and weighed. The results were as follow:s When the pipe was naked 862 pounds of steam were condensed, the average pressure in the pipe being 79 lbs. When the pipe was covered with "plastic material," 480 lbs. of steam were condensed, the average steam pressure being 80 lbs. When the pipe was covered with asbestos, hair felt and paper, 222 lbs. were condensed, with the steam pressure at 77 pounds. It is evident that the loss of heat from the naked pipe was very large, and that the greater part of this loss could be saved by applying a non-conducting covering that was certainly not of prohibitive cost. To cover a pound of water, at (say) 180°

Fahr., into a pound of steam at 79 lbs pressure something like 1030 heat units are required. To evaporate 862 lbs. of water under like circumstances 862 x 1030 equal 887, 860 heat units would therefore be required; and this would correspond to a waste of about 18 tons of coal per annum—not a very large quantity, it is true, but yet a quantity well worth saving. This calculation is based on a day of ten hours. In a plant running twenty-four hours a day, the annual waste, would be about 43 tons of coal. No covering would save all of this waste, of course, but, as the tests quoted above show, it is quite possible to save three-fourths of it, and very likely a larger porportion could be saved if a higher grade covering were used. Almost any covering would probably pay for itself in a short time.

Radiation losses are not by any means confined to the piping, and it is not uncommon to find planst in which the piping is carefully covered, while the upper surfaces of the boilers are left bare. The loss of heat from the boiler itself is not so evident as the loss from piping, because the water of condensation merely falls back into the main body of water below, and does not force itself upon the notice of the engineer. Nevertheless, there is a considerable loss of heat from unprotected upper surfaces of shell boilers, although the loss per square foot of exposed surface is not so great as it is apt to be in piping, because the temperature of the air immediately over the boilers is higher than it usually is around the piping. The roof and walls of the boiler house form a kind of pocket in which the hottest air of the room collects; and as it is evident that there would be no radiation at all this air were just as hot as the boiler, so it also must be evident that the radiation fro the boiler must be less, under the actual conditions, than it would be if the air over the boiler were cool. Nevertheless, the the radiation from the top of an uncovered boiler must be large, and it is far better practice to provide a covering of some sort or other. The objecting to a covering is that unless it is removable the boiler is not accessible on its top surface for examination. On this account coverings of sand or other similar material that are so common are not to be recommended; but a covering may easily be provided that is removable in sections of canvenient size, and the radiation from the top of the boiler may be kept within reasonable limits in this manner without sacrificing accessibility.

Another common source of heat loss consists in leakages of various sorts. A feaky blow-off pipe will discharge a considerable quantity of water during a year. To illustrate, let us suppose that in a battery of boilers there is enough leakage through the blow-offs to bring the total loss of water from this caure up to the moderate amount of one quart (or, say, 2 lbs.) per minute. Assuming that the tempertaure of the water in the boiler is 250° above that of the unheated feed water, it is easily seen that 500 units of heat are expended every minute in heating water that is immediately discharged into the sewer. If the plant runs 24 hours a day, and 365 days a year, a very simple calculation will show that we are wasting about 15 tons of coal per annum in this very common manner. The moderate loss by leakage from the blow-off that has been adopted as the basis of this calculation is often greatly exceeded in actual practice without attracting much attention, especially when the blow-off discharges into a sewer, or other place where the drip from it would not be likely to be noticed. In fact, leakage of this sort is sometimes so serious that it forces itself upon the engineer's attention through his inability to keep the water level where it belongs, even with the pump running all the time. Engineers who are fond of mathametical exercises may find it interesting to estimate what the loss of heat would be under such circumstances as those mentioned.

Leakage from the blow-off pipe may be due to the lodgement of scale in the valve, preventing it from being properly closed, or to wear and corrosion of the valve itself. If it is due to an obstruction, it may be only temporary, because the obstruction is likely to be blown out when the valve is next opened, unless it is unuasually large; but if it is due to deterioation of the valve proper it is likely to go on for a long ime, because, for some reason or other, repairs to the blow-off are apt to be neglected until its condiction is such that they can be put off no longer. This is all wrong; it pays to watch the blow-off pretty carefully.

Another cause of waste consists in the excessive use of the blow-off for flushing the boiler out. The blow-off cock ought to be opened once or twice every day, when the water in the boiler is quiescent—before brightening up the fire in the morning, for example, if the boiler has been lying with banked fires at night. It is impossible to give any general rule for guiding the engineer or fireman as to the quantity of water he should blow out at such times, because the character of the feed-water varies greatly in different parts of the country. It may be said in general, however, that the prevailing impression appears to be that a large body of water should be out at such times, under all circumstances. This is certanily not a correct idea.

If the water is bad, more must be blown out, of course, then would be necessary if it were good; but even when the water is soft and comparatively free from scale forming matter, it is by no means uncommon for the engineer to fill the boiler up and then blow down three or four ins. As has been said, no general rule can be given as to this particular point, but when the water is fairly good any such quantity as has been indicated above is excessive. Usually it will be sufficient to the cock wide until the blow-pipe is thoroughly flushed out; and any blowing that is done after this may be regarded as excessive and wasteful of heat. If a quantitative estimate of the loss from this cause is desired, it may be said in a general way that engineers not infrequently waste from five to ten tons of coal per annum per boiler, by too liberal blowing off.

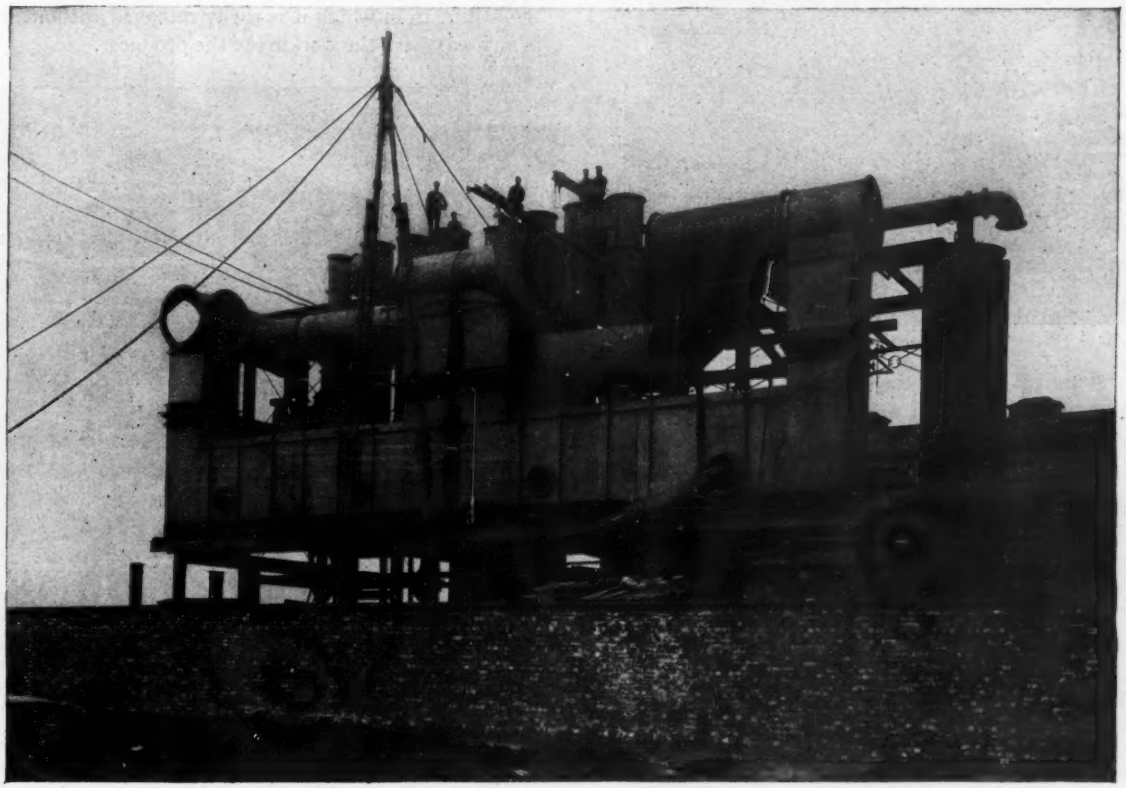
Leakage of steam around fittings and through the afety valve is another important cause of loss, and the magnitude of this particular loss is often surprising to those who have not figured over it. To illustrate, suppose that there is a leak around a pipe fitting that is 1 in. long and 1-100 in. wide, the total area of cross section (or discharge area) of the leak being, therefore, 0.01 sq. in. Next, suppose that the pressure within the pipe is 90 lbs. above the atmosphere. Then it is easily found, by the aid of the usual formulas for the flow of steam through orifices of this sort (Napier's, for example), that under the circumstances here assumed the discharge of steam through the tiny orifices mentioned will amount to no less than 54 lbs. an hour. This loss, continuing for 24 hours a day, and for 365 days a year, would call for the consumption of approximatily 30 tons of coal a year. It is evident, therefore, that steam leaks even through that very small, should be looked after very sharply. It is not at all uncommon, even in plants that are run upon a good, sound basis in most respects, to see much more coal wasted through small steam leaks than the 30 tons that correspond to the particular example selected for the purpose of this illustration.

The Production of Mond Gas

A NOVEL AND INEXPENSIVE GAS FOR BOILER FIRING

The ideal method of firing a boiler is, without doubt, with gas. No other system yet devised will permit of the same ease of operation, freedom from dirt, and certainty of result as the gas burner, but, with the exception of the natural gas belts, its application to boiler firing is to expensive an operation to permit of its use. However, this article is written in order to, in a measure, explain a system of gas manufacture which promises to revolutionize present methods of heating.

Mond gas is the outcome of many years of scientific research and of practical experiment upon a large scale. The processes for its production, and for the recovery of ammonia therefrom, were patented by Dr. Ludwig Mond, F. R. S., and developed at the works of Messrs. Brunner, Mond & Co., at Northwich, Cheshire, England, where about 700,000 tons of slack coal have already been utilized in the gas producers. The experience gained in operating upon so large a quantity of fuel has resulted in the perfecting of the plant and apparatus employed, and has, it would seem, placed this process beyond the realm of experiment.



View Showing the Mechanical Gas Washer at the Works of the Trafford Electric Supply Company, Ltd., Trafford Park, near Manchester

The first apparatus was installed for the jurpose of gasifying a few hundred pounds of the slack, or poor coal, which apparently was of small value for anything around the factory. From this relatively small beginning the gas producer plant at Northwich was step by step enlarged and extended in order to meet the ever-increasing calls that were made upon it as its many advantages were recognized and apprieciated, until at the present time it is capable of gasifying daily some 250 tons of slack, from each ton of which there is obtained the ammonia equivalent of about 90 pounds of sulphate of ammonia, and from 140, 000 to 160,000 cubic feet of Mond gas, equal to about 37,000,000 cubic feet per day. The immense volume of gas thus generated day by day is employed in a variety of ways: it provides fuel for heating and evaporation, and in addition to being put to various other uses suited to the special requirements of the chemical industry there carried on, including some of the most important operations of the works dependent for their success upon the absolute reliability and constancy of the gas, it also provides fuel for the large gas engines that are used for the generation of electricity for the works, and for lighting the neighboring township of Northwich.

The advantages claimed for this gas are so many, and the price of its manufacture so small, that it will be of interest to know the system of manufacture.

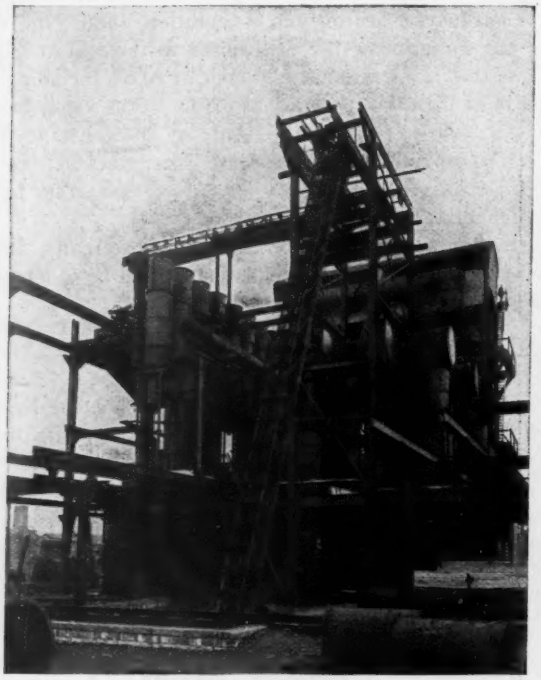
The employment of gas reduces boiler repairs considerably, and also the general expense and annoyances incident to the fire-room in addition to the great saving in labor.

In the next place the cost of manufacture of this gas is said to be but one cent per thousand feet, securing from the coal about 85 per cent. of the total heat energy contained in the fuel; and it can be made from the cheapest quality of coal, thus obviating the necessity of expensive steam coal in the plant.

One gross ton of rough slack produces as a minimum about 140,000 cubic feet of Mond gas of a calorific value of 140 B. T. U. per cubic foot.

In every steam plant working with a variable or intermittent load, a considerable proportion of the fuel consumed is wasted. Some loss under this head is unavoidable, but the employment of gas reduces such stand-by losses to a minimum.

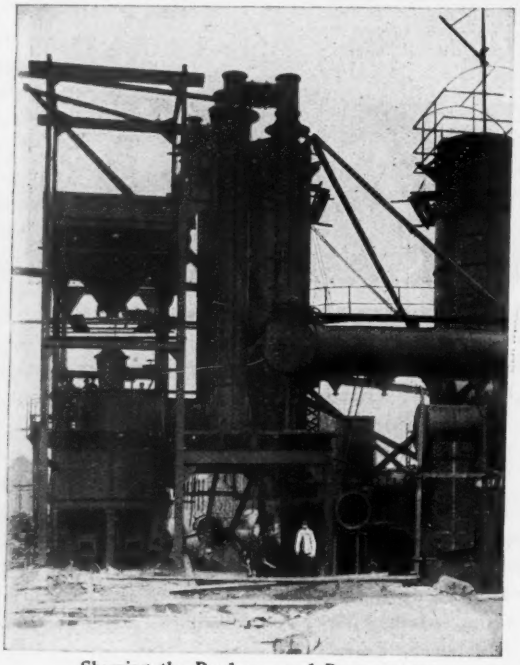
Mond gas is, therefore, very advantageous for intermittent working; the losses of a 1000 horse-power plant when standing being about 224 pounds of fuel per night of 14 hours.



Coal Elevator and Conveyor

When standing for eight days, the losses of a 1000 horse-power Mond gas plant are at the rate of only about 7½ pounds per hour, and the plant can be restarted in a few minutes.

After the week-end stoppage, the time required for starting



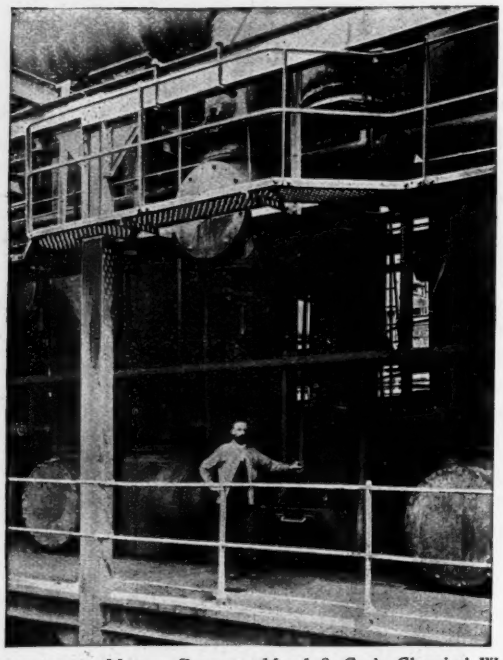
Showing the Producers and Regenerators

a Mond gas plant generating 1000 horse-power is only three minutes.

The following description and the accompanying diagram of the method of production of Mond gas, with the recovery of ammonia therefrom, will serve to make it easily understood, and the illustrations from installations already in operation will give an idea of the plant and apparatus employed.

Wherever possible the slack to be gasified is discharged direct from the railway trucks into an elevator boot. From this boot the slack is mechanically conveyed to the storage hoppers. The first of the illustrations shows a typical coal elevator and conveyor; the second, a set of storage hoppers, showing their position above the gas producers. From these coal hoppers the slack is fed into the producers, where the combustible matter is converted into gas. The illustrations from the installation at Messrs. Brunner, Mond & Co's Winnington works gives a very good idea of the appearance of the producers.

The producer is provided with a water seal, and is so constructed as to allow the ash, which is the only residue, to descend into the water, from which it is easily removed without interfering in any way with the working of the producer.



Regenerators at Messrs. Brunner, Mond & Co.'s Chemical Works

The process of combustion in the producer is carried out at a comparatively low temperature, with the two-fold object of preventing the formation of clinkers in the producer of providing against the destruction of the ammonia. This is accomplished by introducing into the producer a blast of hot air and steam. The quantity of steam required, and when it is desired to recover the ammonia from the gas, is eqal to two and a half tons for every ton of fuel gasified, but of this amount one ton is automatically recovered in the way hereafter described, and this is used over and over again. In the case of installations where it is not proposed to recover ammonia, the quantity of steam necessary is reduced to about one ton for each ton of fuel gasified.

After leaving the producer the gas passes through a regenerator so arranged that part of the heat of the gas and steam entering it is transfered to the blast of air and steam on its way from the air-heating tower to the producer, the gas being consequently cooled to a corresponding extent.

The gas is then delivered into a mechanical washer, a rectangular iron chamber, where it is thoroughly washed with water thrown up into a fine spray by a system of rapidly revolving dashers. By the intimate contact thus obtained with the waters the temperature of the gas is further reduced, and all the dust and sooty substance are washed out of it. These are easily removed by arrangements of flutes in the side of the washers, as shown in our illustrations. After the gas has thus been washed, the next step is the recovery of the ammonia contained in it, and for that purpose the gas passes through the acid tower.

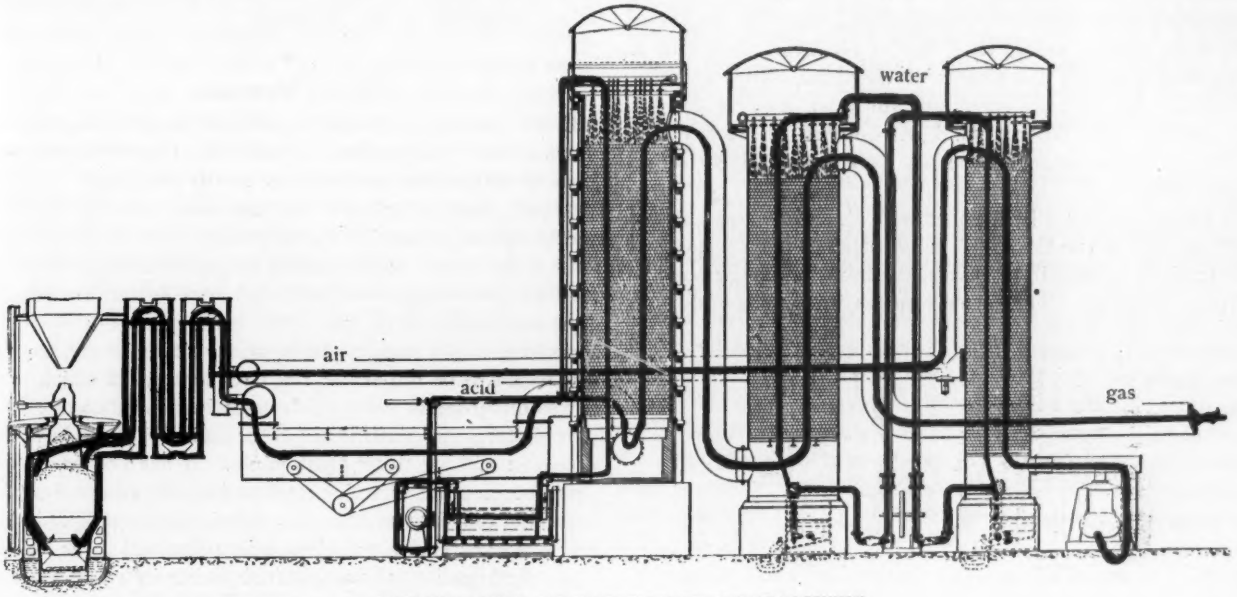


DIAGRAM OF MOND GAS PLANT WITH BY-PRODUCT RECOVERY.

While the gas is passing through the acid tower, the ammonia is almost completely washed out by a weak solution of sulphuric acid, with which it enters into combination, thus forming sulphate of ammonia. This acid solution of sulphate of ammonia circulates through the acid tower again and again, until it contains from 36 to 38 per cent of sulphate of ammonia. In order to provide for the continuity of the process, fresh supplies of sulphuric acid are from time to time added, and corresponding quantities of the sulphate liquor are withdrawn and evaporated, thus yielding solid sulphate of ammonia of good quality which finds a ready sale.

The gas having now given up its ammonia, is next passed through the gas-cooling tower, where it is subjected to a further cooling and cleaning by means of a downward flow of cold water. It is then ready for use, and passes direct into the mains leading to the works.

As gas is cooled in this tower, the steam with which it was burdened becomes condensed, and the water which entered the tower as cold water, is delivered from it as hot water, and this, after passing through a vessel suitably constructed for separating the tar which is mixed with it, is again pumped to the top of the neighboring air-reheating tower, when it serves to heat the air blast required for the producer.

Into this air-heating tower, a blast of air is forced by a blower, and its contact with the descending stream of hot water results in the production of a hot-air blast saturated with vapor which is duly carried into the regenerator and thence delivered into the producers, as already described. The water which was delivered hot into the top of the air-heating tower, after having transferred its heat to the air blast, is drawn off sufficiently cold at the bottom to be returned to top of the gas-cooling tower to repeat its cycle of utility. This method of continuously employing water in circulation as theheat-carrying agent between the hot gas in one tower and the cold air in another, and the method of recovering from the hot gas, by this continuous cyclical exchange of heat, a large porportion of the steam required for the producer blast form distinctive features in the economy of the process.

Features of the Electric Motor

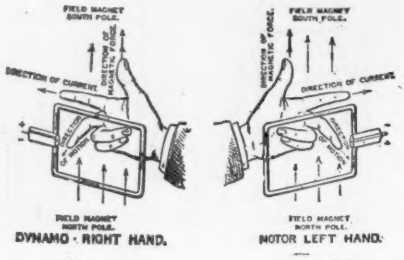
Any direct current dynamo will act as a motor if supplied with current from some external source. This source may be a constant E. M. F. system, a constant current system, or any other system. It is evident that if the negative and positive terminals of a dynamo be connected with the corresponding terminals of some external source of supply, the direction of flow in the armature will be reversed. Irrespective of the multipolarity of the field or of the method of armature winding, the electro-dynamic actions between the field and all the currents in the inductors will conspire to produce rotation in one direction.

To determine the direction of movement of an inductor carrying a current of known direction in a magnetic field of known direction, one may employ a modification of Fleming's rule. Thus in a dynamo the thumb and two first fingers of the right hand determine the direction of induced E. M. F. as shown in Fig. 1. But in a motor the thumb and two first fingers of the left hand can be made to determine the direction of motion as shown in Fig. 2.

If in a dynamo the direction of the field flow be not altered, and if the armature be supplied with a current flowing in the same direction as when the machine was operated as a dynamo, the direction of rotation will be reversed. Thus, if the positive brush of a dynamo be connected to the positive terminal of an external source of supply, and if the negative brush be connected to the negative terminal, then the direc-

tion of current flow in the armature will be reversed. The direction of rotation of the armature, in series-wound machines, since the field flow has its direction also changed, will be reversed. In shunt-wound, separately excited, and magneto machines, since these do not have their fields reversed, the direction of rotation will be unaltered. Compound-wound machines will have the same or reversed direction of rotation, depending upon whether the magnetizing effects of the shunt coils is stronger or weaker than that of the series coils. In a compound generator the actions of the shunt coils are cumulative, i. e., in the same direction; but when used as a motor the actions are differential, i. e., opposed to each other. Motors are also wound so as to have cumulatively acted series coils.

If an electric motor be supplied with electrical energy, it will vary its rate of rotation until it has attained such a speed as will produce an equality between the input of energy and the output of energy. The latter appears both as useful work



and as losses. In the case of a motor, speed acts toward electrical energy like temperature in the case of heat energy. Temperature always rises until the heat energy which is disposed of by conduction, convection and radiation and the electrical energy which is communicated to a motor is transformed into the useful mechanical energy, which is taken from the armature shaft either by a belt or by direct connection; b, into friction at the bearings and at the brushes; c, into windage; d, into foucault and eddy currents; and finally e, into ohmic heat energy in the motor's electrical curcuits. The energy required per unit of time to overcome friction, windage, hysteresis, and foucault and eddy currents increases as the speed of rotation increases. Nearly all practical loads put upon a motor—machinery in one form or another—require an increase of power for an increase of speed. Therefore, if a given amount of electrical power be communicated to a motor under load, the armature will assume some speed of rotation, so that a balance between the output and the input of energy is maintained.

If the variation of losses and useful energy with the speed were the only conditions governing the speed, then there would result in practice variations of speed through enormous ranges. But there is another condition affecting the speed. The armature, by varying its speed, not only governs the rate of expenditure of energy, but also governs the amount of electrical energy received. The armature of a motor revolving in a field under the influence of supplied electrical energy differs in no respect from the same armature revolving in a field under the influence of supplied mechanical energy. There is an E. M. F. generated in it which is determined by the speed and quanity of flow. For the same speed and the same flow there would be generated the same E. M. F. in the case of a motor as in the case of a dynamo. The direction of this E. M. F. is, however such as to tend to send a current in a direction opposite to that of the current flowing under the influence of the external supply of E. M. F. Therefore this pressure which is induced in the armature of a motor is called counter electromotive force. The current which will flow through the inductors of an armature is therefore equal to the difference between the supply E. M. F. and the counter E. M. F. divided by the resistance of the armature.

Boiler Materials

Boiler making holds an important place among the mechanical arts. Its progress has been aided chiefly by the enormous growth of the steam-engine as the prime mover, by the increased facilities afforded for procuring suitable materials, and by the improvements made in working them. In the early days of the steam-engine, boilers of copper and cast-iron were used for generating steam, and they were seldom subjected to a pressure higher than that of the atmosphere; but when pressures of 3 to 4 or even 7 atmospheres came into use, cast-iron was found to be unreliable and treacherous, for which reason it was discarded in favor of wrought iron, which was not employed at first, in consequence of the difficulty found in working it and in making steam-tight joints. It has however, of late years become the material employed to the almost entire exclusion of cast-iron and copper. Steel, also, is gaining in favor and is now extensively used both for tubes and shells.

The first quality to be sought for in boiler materials is strength This does not necessarily imply the mere power to resist being torn asunder by a dead weight, as in a testing-machine; but the quality to withstand, without injury, the varying shocks and strains to which boilers are exposed. An inferior quality of plates cannot be relied upon to bear the ordeal of heating and cooling repeatedly, as they invariably warp and twist, showing defects of manufacture; more especially in the process of cold bending, when minute fractures often occur on the outer surface of the plates of stubborn or inferior qualities of iron.

The defect most commonly revealed in working boiler-plates is want of lamination. This defect arises from the imperfect welding of the several layers which make up the thickness of the plate, and is usally caused by interposing sand or cinder, which has not been expelled by hammering or rolled out during the process of manufacture. This is more frequent in thick than in thin plates, and is sometimes very difficult to detect in cold plate, although often discernible in the hot. It also happens that plates that are passed as quite sound, on careful examination are found to be severely laminated when subjected to heating and hammering, and prove totally unfit for use.

Blisters are of similar nature, and arise from the same cause as lamination. Sometimes they appear as mere surface defects, and are of no consequence; but their appearance may be an indication of want of care or skill in the making of the plate, and should always excite suspicion. It frequently happens that these defects pass undetected after the closest scrutiny and test by hammering, but disclose themselves soon after the boiler is set to work, especially if the plates be exposed to sudden variations of temperature. In the plates over the fire-grate of an externally fired boiler, such a blister may prove a very serious defect, and often necessitates the cutting out and replacement of the sheet. Inferior brands, of iron will rapidly show unmistakable signs of weakness when placed under the trying ordeal of bearing the alternate impingement of a fierce flame and cur-

rents of cold air. The rapid variations of temperature caused by the sudden and frequent openings of the furnace door, and passage of cold air through the grate-bars, will soon tell on even the best iron, but more quickly on that of an inferior brand.

On breaking a plate or bar of wrought-iron, the fracture presents an appearance by which the quality of the iron may, in some measure, be determined. The fracture is designated, on the one hand, as fibrous, tough, silky, close-grained, etc., or, on the other hand, crystalline, coarse, open-grained, brittle, and cold-shut. When broken suddenly, the best qualities of plate and bar iron exhibits a fine, close-grained, uniform crystalline fracture, even silky, of a light silver color; the appearance in the harder descriptions approaching to that of steel. The appearance of indifferently refined and inferior qualities is coarser, usually of a darker color, more or less uneven, or open, exhibiting large facets, and approaching some descriptions of cast-iron. When broken gradually, good iron presents a well drawn out close fibre, of light greenish hue, whilst inferior qualities give a shorter, more open, and darker fibre.

When good ductile iron is gradually torn asunder, it stretches to a considerable extent, causing a diminution of sectional area at the fractured part, which should always be compared with the original sectional area of the specimen in judging of the quality. An inferior bar or plate may bear as great a tensile strain as a, similar specimen of superior quality; but on comparing their fractured areas it will generally appear that the latter has been drawn out considerably, whilst the inferior specimen, having stretched but little, has not sensibly diminished at the fracture. This is owing to the fact that good ductile iron, when sudden strains occur, will stretch, while badly refined will snap. Wrought-iron changes from fibrous to crystalline, after enduring long-continued cold hammering, vibration, tension, jarring, and other strains, after long exposure to the influence of heat, or alternate expansion and contraction whenever it has been used for the plates of a boiler furnace. Even the very best plates, after from ten to twenty years' use in a boiler, have frequently been found to break without stretching, at the same time displaying a crystalline fracture.

It has been said that this shows that a change has taken place in the nature of the material, and that, from being fibrous and tough, it has, by some unexplained cause, become crystallized and brittle, or that it has lost its nature in consequence of the treatment it has undergone, whatever that may have been. There is no doubt that the strains or other causes above mentioned have a tendency to make good iron become brittle and liable to snap suddenly under the same treatment that would originally have torn it gradually, and to this extent a change is produced in its nature. This snapping, and not the fatigue of the metal, is the direct cause of the crystalline fracture, which is but a necessary consequence of the suddenness of the breaking, and not a property of the iron itself. To say it snaps readily because it has become crystalline is to confound the cause with the effect. It is erroneous to say the fibrous nature has passed out of the iron, as its ductility can to some extent, at least, be restored, in most cases, by simply heating to a bright red, and slowly cooling, the iron, or failing that, by hammering or rolling it while hot. By heating to redness, and suddenly cooling, a piece of wrought iron, it will become liable to snap, producing the same effect as cold hammering. The explanation of this is not clear, and it may be owing to the loosening of the crystals into which the composition of the material ultimately resolves itself. To this cause may also be attributed the same tendency to snap after long-continued jarring or alternate expansion and contraction.

It may be asserted, without fear of contradiction, that all boiler plate worthy of the name is fibrous; whether its hardness makes it liable to snap, and, therefore, appear crystalline, depends on its original character and the treatment it has undergone. No fine iron can, however, by any treatment, except burning, be made to appear coarse, and the fibres of the poorest descriptions of iron cannot, without refining, be made to appear fine and close-grained. From a want of knowledge of the above facts, false opinions are often expressed respecting the qualities of boiler plates.

It is no unusual thing to find intelligent mechanics and boiler-makers expressing their opinions, at coroners' inquests, on the quality of the iron in exploded boilers, without anything to base their opinions on except the load per square inch required to tear the plates asunder. They seen to forget, if the boiler be an old one, that the age, the position in the boiler in which the rent has taken place, the amount of strain to which it has been exposed, and all the circumstances connected with the occurrence, should be known in order to decide understandingly as to the quality of the iron. It has been shown, in numerous instances, that good ductile iron can be made to appear crystalline when pulled asunder in the testing-machine, by confining the minimum sectional area where fracture will occur to one point or to a very short length.

The general conclusions with regard to boiler material, which may be regarded as established from experiments, observations, and practice, thus far seem to be,—1st, That the laws of resistance of the parts of boilers to the internal pressure are sufficiently well established; 2d, It is of the utmost importance that the materials employed should be of the best quality as regards strength and durability; and as there are but few manufacturers of boiler-plates, the inspection of materials, especially boiler plates, should be made by competent persons, appointed for that purpose, at the place of manufacture, which inspection should extend to the qualities of ores and the process of manufacture, the required brands, stamps, or certificates being put on or authorized by the inspectors in person. There is much greater certainty of securing the best materials by an inspection of the process of working, and of the raw materials employed, than by an inspection of plates after they have been sent to market, when, judging from all external appearances good, and bad plates are not easily distinguished.

The proper strength of boilers, in order to enable them to withstand with safety the required pressure of steam, is a matter of much importance as regards both life and property, and the responsibility of the proprietors and constructors of boilers is of so grave a character as to justify the devotion of a much larger space to this subject than is convenient in this work. The principles on which the strength of the material depends may be expressed in a very few words,—the strength being directly as the thickness of the metal, and, inversely, as the diameter of the boiler.

So long as the quality of boiler-iron remains as it is at present, the thickness of the plate may be practically determined within exceedingly narrow limits, as a good boiler must be constructed of plate ranging in thickness from 1-4 to 3-4 of an inch, as anything less than the former cannot be properly caulked, and any thickness greater than the latter is difficult to rivet without

the aid of machinery. A thickness of 3-8 seems to have become the standard thickness for all diameters of boilers intended to sustain a high pressure. This, perhaps, arises from the fact that boiler makers seem to be better acquainted with the practical limit to the strength of that thickness, because it has of late years been used more than any other; nevertheless, for steel, or some of the higher grades of American plate, a less thickness will suffice for the same pressure.

As already stated, the materials now commonly used for the shells of boilers are wrought iron and steel. The specifications for this material vary somewhat in different localities, but the following, being that of the Board of Trade, is much used: The material to have a tensile strength of from 54,000 to 64,000 pounds per square inch, to show an elongation at the point of rupture of not less than 18 per cent in 10 inches, but should be about 25 per cent, and, if annealed, not less than 20 per cent. Strips 2 inches wide to stand bending until the sides are parallel at a distance from each other not greater than three times the thickness of the plate. In some other requirements the contraction of area is specified instead of the elongation, and in some instances both the elongation and contraction of area cross section are specified.

For stays the Board of Trade requirements are that the tensile strength shall lie between 54,000 and 60,000 pounds per square inch, with an elongation of not less than 20 per cent in 10 inches. Steel which has been welded or worked in the fire should not be used.

If wrought iron is used, it should have a tensile strength of not less than 45,000 pounds per square inch, and an elongation of 15 per cent in 8 inches. If steel is used, the elongation of be not less than 26 per cent in 8 inches, and after tempering the test bar should stand completely closing together. Experiments seem to indicate that, so far as leakage is concerned, iron is preferable because it is not subject to the same degree of expansion and contraction as steel.

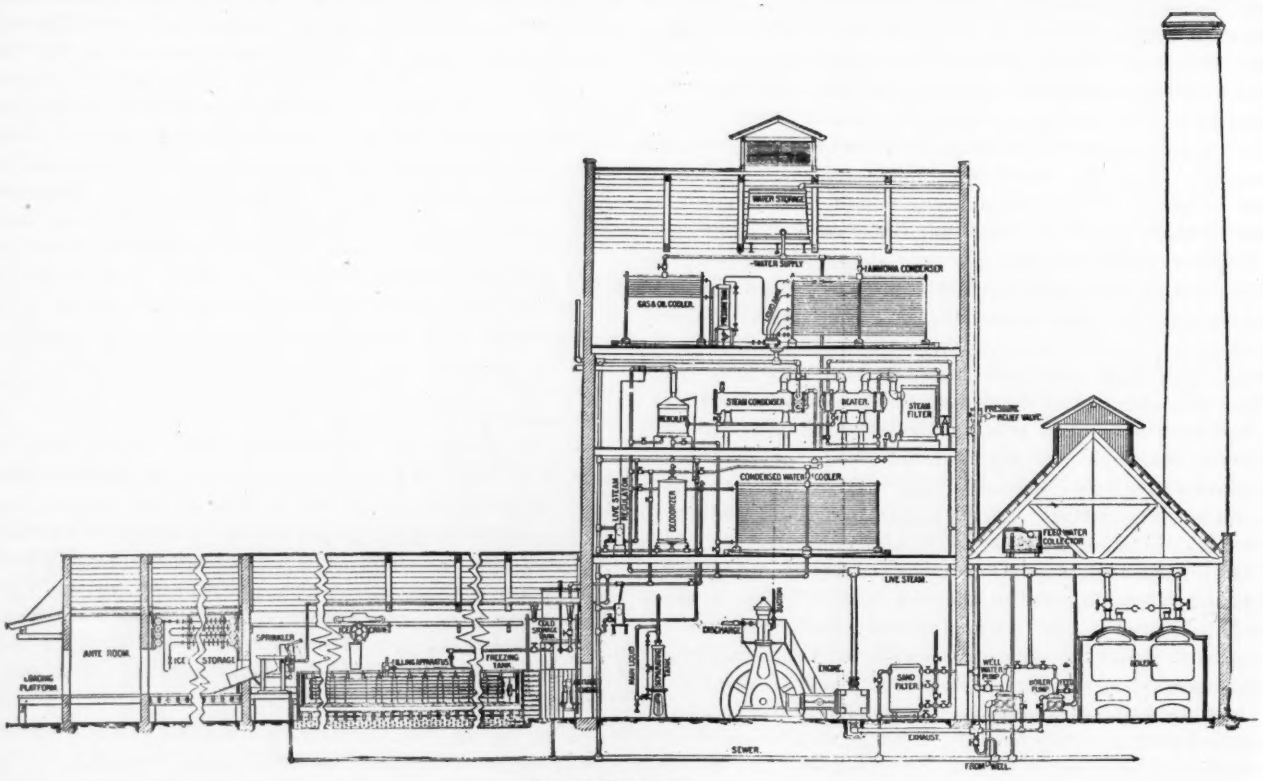
The Principles of Ice Manufacturing

In describing the cycle or cycles of operations for an ice plant as carried out in practice, the steam part of the plant is brought prominently into the system, as the condensed exhaust is used to supply a part of the water from which the ice is made.

The parts of the system shown in diagram Fig. 1, are the boiler plant, steam engine, compressor, fore cooler, oil separator condenser, storage tank for liquid ammonia, expansion cock, expansion coils, steam filter, condensed water cooler, re-boiler, filter or deodorizer, cold water storage tank, and freezing tank.

The brine is used in the freezing tank as a medium for the transfer of the heat from the expansion coils to the freezing cans. The exhaust steam travels from the cylinder through a steam filter and feed-water to the steam condenser, thence to the re-boiler, passing from the re-boiler to the filter, from which it goes to the cold water storage tank, ready to be drawn off into the cans. The office of the re-boiler is to drive impurities to the top, and drive out the air. A skimmer carries off the scum, and the air passes out at the top, the cleansed water being drawn off from the bottom.

The process is continuous, the cans of ice being removed at such intervals that, on the removal of one, enough distilled water has been collected to fill another can. It will be readily admitted that to conform to the requirements of a properly arranged plant calls for a rather complex and elaborate arrangement. One method of carrying out the idea will be now described. It is understood, of course, that the plans may be modified to suit varied places and conditions.



General Plan of Plant

The ammonia compression plant is essentially the same as that adapted to refrigeration in general. This is part of the plant occupying the first and fourth floors shown in the cut. The compressed gas rises to the gas and oil cooler or fore cooler, the oil is retained in the oil separator or pressure tank, and the gas, after being liquified in the condenser, descends to the first floor, where the separarting tank is placed, which is intended to trap any oil remaining in the liquid. The liquid is fed as required from this tank into the coils of the freezing tank, from which it passes again in the form of gas to the compressor.

To follow now the water from the well to the loading platform, where it is delivered as ice, we begin with the well water pump in the boiler house. See Fig. 1. The water from this pump splits into two currents, one of which rises to the top of the building and discharges into the water storage tank. This water, as shown by the pipes leading from the tank, flows over the gas and oil cooler and also over the ammonia condenser. From the pans or cemented floors on which these stand, it flows to the floor below, where it enters the steam condenser. After traversing the condenser it passes through the next floor, runs along the ceiling, and empties into the vertical stand-pipe (seen to the extreme left) connecting with the sewer. Water from the storage also flows by a pipe (hidden by the ammonia condenser) to the condensed water cooler, from the base of which it passes through the floor, runs along the ceiling of the first floor, and empties into the sewer standing pipe.

This disposes of one current from the well-water pump. The other passes through the sand filler whence it arises to the third floors and passes through the heater. From this heater it again desends to the feed-water collector in the boiler house, whence it is drawn off by the feed-pump, and by it sent into the boilers. It leaves the boilers in the form of live steam. The pipe conveying this live steam has branches supplying the engine, the well water pump, the boiler-feed pump, and is continued along ceiling of the first floor, rising to the third floor, where it is connected with the re-boiler and also with the steam filter.

The purpose of its connection with the re-boiler is apparent, the connection with the steam filter is utilized to automatically supply a small quanty of live steam to make up for any deficiency in exhaust steam. Other connections of the live steam pipe to the various apparatus are shown, which are used for cleaning out.

The exhaust steam from the engine, and also from the two water pumps, passes beneath the first floor and rises through the boiler room and outside the main building to the third floor. Before it enters this it has a chance to escape through the pressure relief valve, if for any reason the various apparatus through which it passes should cause sufficient back pressure to impair the proper working of the engine.

The exhaust steam passes first into the steam filter, thence into heater, where it heats the water which, as we have already seen, passes through this same heater on its way to the boiler.

From the heater it passes to the condenser, thence to the re-boiler. From this it goes through the condensed water cooler to the deodorizer on its way to the cold storage tank. The names of these various pieces indicate their functions, and need no description.

From the cold storage tank it is fed by a hose to any can put in a place rendered vacant by the withdrawal of a can of ice. There we must leave the now thoroughly purified and distilled water in repose for some sixty hours. After this interval of time, the can is lifted by the ice crane, suspended from the carriage of which it is run down the tank room to the sprinkler. In the sprinkler the can is left to take care of itself. Here it receives a shower bath of warm water and when loosened drops out of itself and glides into the ice storage room, the sprinkler in the meantime automatically putting itself into position to receive another can, thereby shutting off the supply of warm water.

The cake of transparent ice is allowed to remain in the ice storage room until the time for the wagons to appear at the loading platform approaches, when it and as many of its fellow blocks are required are withdrawn iato the ante-room. A block of ice may pass straight through the ice storage room and the ante-room to the loading platform, or it may remain a week or two in the storage. This ice storage room is seen to be supplied with refrigerating pipes so that if the demand is fluctuating the blocks will be preserved intact, only so much being withdrawn into the anteroom as is necessary for immediate use.

Ventilating Equipment for a Turkish Cruiser

The recent disturbances in the Orient have directed much attention to the fighting resources of the Turkish government. While the Turkish army appears to be courageous and fairly well equipped and drilled, it is a matter of common knowledge that the Turkish navy is practically non-existent, the few vessels in commission being old and out of repair. However, the Sultan is taking active steps to remedy this deficiency, and Wm. Cramp & Sons, of Philadelphia, are now building for the Ottoman Empire a large cruiser, to be named the "Medjidia."

This vessel will embody the latest improvements in naval construction, and will be an effective fighting machine in every way. One feature which has been looked after with particular care is the ventilation, which is of very great importance in a vessel serving in tropical or sub-tropical waters. Nine electrically-driven centrifugal fans furnished by the B. F. Sturtevant Co,, are provided to ventilate the hull of the "Medjidia." Fan No. 1 is a 40-in. steel-plate "exhauster" which will supply air above the protected deck, forward, while No. 2 of the same size will supply air below the protected deck forward. Fan No. 3 is an exact duplicate of Fan No. 1 and will supply air between frames 65 and 66 aft. No. 4, of the same size, will furnish air aft of frame 66. No. 5, which is a 50-in. steel-plate "exhauster" will supply air to the dynamo and evaporating rooms. No. 6, a "Monogram exhauster" having a cast-iron housing, will supply air to the crew's quarters between frames 10 and 24. This fan is bolted to the ceiling and is driven by an electric motor supported on the side of the fan. Fan No. 7 which furnishes air to the crew's quarters between frames 24 and 34 is similar to Fan No. 2. Fan No. 8 for the crew's quarters between frames 34 and 35 is a duplicate of Fan No. 6., and Fan No. 9, of the same size and character, furnishes air to the officers' quarters between frames 55 and 85. The 40-in. fans are capable of supplying 4260 cubic feet of air at 1 ounce pressure when running at 822 r. p. m. and 1 1-2 ounces when running at 1010 revolutions. The 50-in. fan will supply 3690 cubic ft. at 1 ounce pressure at 660 revolutions, and 1 1-2 ounces at 808 revolutions. The four "Monogram" fans can supply 2110 cubic ft. of air at 1 ounce pressure running at 822 r. p. m. or at 1-1-2 ounces when running at 1030 r. p. m.

The Practical Engineer

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Indicator Engineering. The steam engine indicator has proved itself to be a potent factor in the accomplishment of economies in steam plant engineering, and the time has come when no engineer considers his equipment complete unless it includes the indicator and its attachments.

The indicator diagram, however, shows but one thing. It represents graphically the pressure per square inch of piston area at every point of the stroke, and nothing more. It is by a study of the relative pressures at the various points that the engineer is able to draw conclusions regarding the action of the steam in the cylinder and thus obtain an idea as to the changes necessary to produce a better steam distribution. He is already aware of the changes of pressure which the card should show under theoretically perfect conditions, and it is by comparing the actual with the theoretical that faults in valve setting are discovered.

The indicator diagram does not point out the specific fault in the valve adjustment or in the construction of the engine. It shows the steam distribution, and from that the engineer must reason out the causes of any irregularities denoted by the card. Many of these are evident at a glance; but many more are not.

Cards from different types of engines may show what appear to be identical faults, so far as the appearance of the cards is concerned, and yet the causes in the two cases may be altogether different. It is not possible, in many cases to declare just what fault is indicated without a knowledge of the type of engine, the nature of the valve gear, and the conditions of service of the engine.

In this, as in other circumstances, "a little learning is a dangerous thing." The young engineer, flushed with the consciousness of added responsibilities, and zealous to accomplish something in the way of higher efficiency or greater economy, is very apt to fall into the error of altering the valve adjustment, first of all, to conform to his ideas of correct steam distribution. For the bare fact remains that such changes are oftentimes more detrimental than otherwise.

Very often, when an engineer is puzzled over some kink or crook in the outline of a diagram, or is somewhat in doubt as to how well his valves are set, he sends a set of cards to the editor of the engineering journal to which he is a subscriber, with the request that any faults be pointed out and desirable changes suggested. It should not be expected that the editor will at once explain the exact cause of every deformation, and it is not reasonable to expect, either, that he will suggest precisely the necessary alterations which will give the best results. The diagram alone does not always tell the whole truth, and the engineer, with both the engine and the diagram before him, has a far better opportunity to discover the trouble than the editor, several hundreds of miles away, with the diagram alone.

A New Element in Boiler Steaming. Contained elsewhere in this Edition of "THE PRACTICAL ENGINEER" is an article upon the manufacture of gas. The subject contains much that will be of interest to engineers in general, as it promises a means of utilizing coal for heating purposes in a way heretofore thought to be impracticable, because of losses entailed in converting the gas into proper shape for use as a heating medium. With the Mond Gas, however, this difficulty is overcome in a manner the efficiency of which is daily being proved by actual practice. Thus it may be seen that in large plants a gas generator of this type will effect a saving of hundreds of dollars per year in the fuel bill. Not only this, but there will be the absence of handling the coal and ashes, combined with the total elimination of the smoke evil.

Efficiency is obtained by converting the fuel into a form in which it can be utilized to the best advantage, uniformly representing the maximum heat energy obtainable therefrom.

Cleanliness naturally follows with the abolition of the smoke nuisance; there is no smoke, and that which formerly caused the nuisance is transformed within the apparatus to combustible gas, and duly supplied either to gas engines, or to the furnaces.

Economy results from every pound of fuel being utilized at its full strength, without waste; from the use of common coal or dross instead of expensive steam coal; and from the

large proportionate reduction in wages. In large installations, the ammonia obtainable from the fuel enables the consumer to save a large proportion of its original cost.

It will be noticed that the cost of manufacture is quoted at one cent per thousand feet—this will at first appear incredible, but as there are several companies in England now selling the gas at a price of four cents per thousand feet, and making a profit, this may be accepted as reliable.

The gas at the present time is of no value as an illuminant, but there is ample room for it in any part of the country in the nature of a heating medium.

A strong element in this gas is also its applicability to gas engine use, enabling the gas engine to be operated at a tithe of the usual cost.

It is interesting to note that the steam required for the Mond gas generating plant can be generated by utilizing the heat contained in the exhaust gases leaving the gas engines. This increased economy is an important consideration, and particularly so in the case of central stations employing gas engines.

Formerly the heat of the gas was wasted, and the steam necessary for the saturation of the producer blast had to be produced in the ordinary way. Results recorded with a 500 H. P. gas engine show that by passing its exhaust gases through a specially designed tubular boiler, their heat can be so efficiently utilized as to provide all the extra steam required in the producer to furnish the supply of gas necessary for the gas engine, thus greatly increasing the fuel economy of the system.

This system of raising steam has already been adopted in one power station, where Mond gas is used to drive large gas engines producing several thousand horse-power, and no trouble or difficulty is experienced in working.

Electrical Phenomenon Explained.

In this and the two preceding numbers of "THE PRACTICAL ENGINEER" will be found interesting articles upon "Electricity" by A. G. Williams. The reader will have noted ere this the extreme scope the author encompasses in his dealing with this subject; but, we wish to call par ticular attention to them as being probably the most interesting and instructive hypothesis of electrical energy, its source, power and possibility, heretofore published. Nor is the author assuming, in his articles, more than he is able to advance acceptable theories and practice for.

With the first article is evolved a practical illustration of the electro-dynamic revolution of the earth, a concise and intensely interesting discourse upon the magnetic influence exerted upon the compass, and the immense volume of electricity contained in the ether.

It has been calculated that the electro-motive force of a bolt of lightning is about 3,500,000 volts, the current about 14,000,000 amperes, and the time to be about one twenty thousandth part of a second. In such a bolt there is an energy of 2,450,000,000 watts, or 3,284,182 horse-power. This is almost inconceivable, yet the author very cleverly explains the source of this power in a very practical manner.

After all we find that many of the great mysteries and miracles performed by the ancients, which for years have been either disbelieved or accepted as supernatural, are quite easily duplicated at the present time by the adoption of that subtle fluid, electricity.

A few weeks ago Dr. Albert C. Geyser, of New York City, with the aid of the X-rays elucidated in a marvelous manner some of the miracles of the Bible.

Dr. Geyser was asked to make a demonstration before the members of the Holy Name Society of St. Anselm's Church, in New York City. He said he felt he would be able to demonstrate that the miracles were in no way inconsistent with science, and invited many friends of his to see his experiments. Though the majority of those in the audience have followed closely the advances of science and knew of the powers of the X-ray, they felt at first that the demonstrations he had planned were not meant for the purpose of strengthening their faith in the literal truth of the Bible. After he had assembled his audience he produced a twelve-plate static electric battery and a table, with which it was connected. This battery furnishes the electric energy with which the X-ray and the Crookes tubes are operated. After setting up his apparatus the physician started the great glass wheels of his battery in action and allowed his audience to look through pieces of thick timber and other opaque bodies. He continued these experiments, reading passages from the Scripture referring to the miracles. He showed how simple it was to produce a halo of electric fire about his head, though he remained at a distance of ten feet from the apparatus. He stood on a raised platform set on glass pegs. The glass prevented electrical contact with the earth, and as he raised the two negative and positive poles to the height of his head the electricity passed through and out of the crown of his head in a circle of flame. Then he compelled his machine by various manipulations to shoot jagged flashes. Next he called attention to the passages of the Bible referring to the descent of the Holy Ghost in a pillar of fire. He said: "If some one will only volunteer I will show that the enveloping of a person in a pillar of flame is not a miracle."

Thomas MacKaye came forward and offered to serve for the experiment. Dr. Geyser placed him on his small platform before the apparatus in a standing position. He adjusted on each side of him the two steel rods forming negative and positive poles. There was no possibility of a short circuit, as the platform was separated from the floor by glass pegs. With a Crookes tube in one hand Dr. Geyser stood off to one side of the platform and signalled for the starting of the big glass disks. They started off with a whirr. Then slowly tiny sparks began to jet off Mr. MacKaye's clothing. Soon the sparks grew to curling flames, and when the disks attained their full speed the man's entire body was a mass of writhing blue and white flame. When he stepped down from the platform not so much as a thread of fuzz of his clothing was singed.

In the face of this and like applications of electricity, the ramifications of Mr. Williams articles will not appear extravagant but rather strengthened.

LETTERS FROM ENGINEERS

IN ORDER to make this department of THE PRACTICAL ENGINEER as interesting as possible, a moderate rate will be paid by us for all contributions published under this heading. However, we do not assume responsibility for the ideas or opinions expressed. None need hesitate to contribute because of inability to draw or write well. We will redraw or revise whenever necessary—it is the idea we want. New ways of doing old things, criticisms of accepted theories, and general engine-room experiences are especially solicited.

The Stephenson Link and Belt

Editor THE PRACTICAL ENGINEER:

Although the action of this gear may be quite familiar to most locomotive engineers, there are doubtless many others operating various types of engines equipped with the Stephenson Link, who may not understand the effect on the lead which is produced by shifting the link. A study of the accompanying

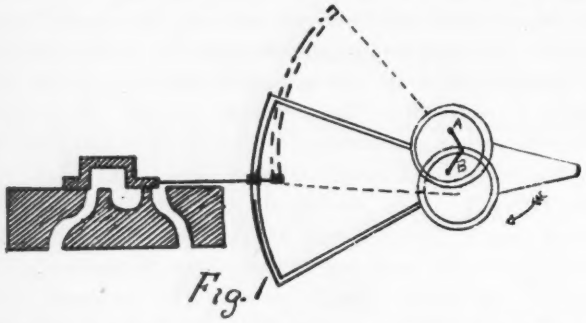


Fig. 1

diagrams and explanations should make the subject clear to any such.

Fig. 1 shows the mechanism with open rods and direct valve connections. A. and B. represent the centers of the eccentrics, and X. a block upon which the link L slides. This block is attached to the valve rod and moves only in a horizontal direction.

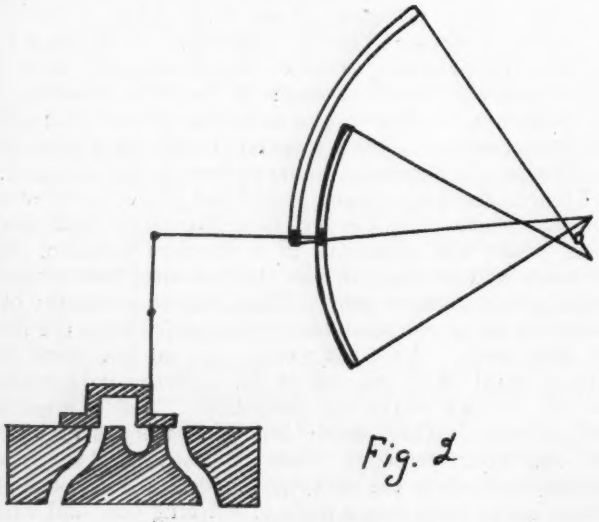


Fig. 2

Regarding the terms open and crossed rods, it might be as well to state that the rods are said to be open if they are open when the eccentric centers are on the same side of the shaft as the link and valve. The term crossed is similarly used. Of course open rods are sometimes crossed, and crossed rods sometimes open, but this does not alter their distinctly different action.

From a glance at the figure the method of reversing an engine by means of this gear can be readily seen. When the link is in the dotted position the valve is operated entirely by ec-

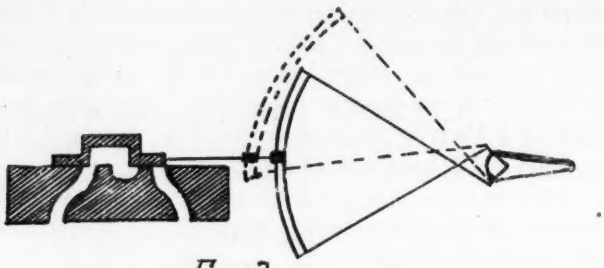


Fig. 3

centric B, and the engine must run as indicated by the arrow. If on a locomotive the engine would run backwards. If it is desired to reverse the motion, the link is dropped so that the valve is moved by eccentric A.

Now if the link is moved so that the rods are equally distant from the block, the valve will be affected by both eccentrics, but that eccentric which is moving more nearly horizontal will have most effect, and the one so moving will always be the one tending to close the valve. For suppose, the engine to be running as in Fig. 1. If the link is thrown into its central position, as shown in the full lines, the eccentric A. in its present situa-

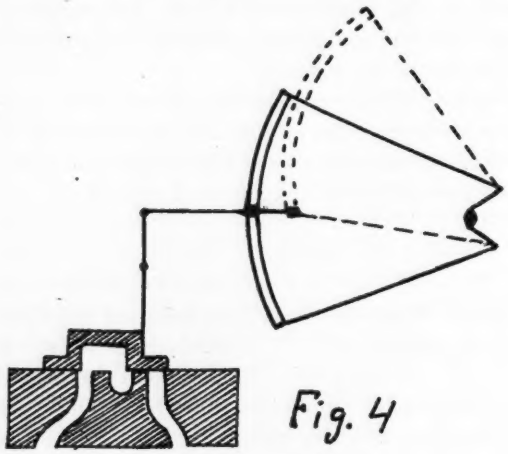


Fig. 4

tion will have most effect, as its motion is more horizontal than that of B. As A. it tends to close the valve the engine must stop.

In the diagram the change in the lead can be easily seen; it is evident here that as the center of the link approaches the block, the lead is increased.

In Fig. 2 is shown the gear with open rods, but with reversing rocker arm. The lead increases as in Fig. 1, when the link takes a central position. The rods are shown crossed in the cut, but would be open when on the valve side of shaft.

Fig. 3 shows the mechanism with crossed rods and direct valve connections. Here, the eccentrics A and B, when acting separately, move the valve as in Fig. 1, but when the centre of link is brought nearer the block, the valve is moved to the right and the lead decreased.

Again in Fig. 4 is illustrated the gear with crossed rods and

reversing rocker. In this and Fig. 2 the true position of valve cannot be shown, as it would be perpendicular to the paper.

The lead must of course be diminished, as in Fig. 3, when centre of link approaches the block.

Summing up, we find that when the rods are open the lead increases as the block approaches the centre of link; when rods are crossed, the lead decreases as block comes towards centre; and no change in the lead is produced by the rocker arm.

The figures showing the block directly in centre of link are only for the purpose of illustrating the effect on the lead, as with the link so placed, the engine cannot run. But the link performs another important duty, which is, to regulate the work done in the cylinder. When the link is shifted so that the block is, say, 3 times as far from one rod as the other, the nearest rod will have most influence on the valve motion; but the other will have some effect in the opposite direction. This will lesson the value travel, and the quantity of steam used will be diminished. The lead will, however, invariably change proportionally as described above.

F. H. STACEY.

A Cheap Crane

Editor PRACTICAL ENGINEER:

A convenient yet cheap crane may be made like Figure 1. As will be seen, it consists of one single forging to which a set of falls is attached. The stay may be hooked to a string in the wall, or a post, and at its foot a strut is welded, which bears against the wall or post, as the case may be. The stay may be made of $\frac{3}{4}$ inch, and the strut of one inch iron. This idea is not new, but is given as a mighty handy thing to have around, when you want to remove a cylinder head, or some other piece too heavy to be conveniently handled without a crane, and where the boss says, "a crane costs too much," as bosses sometimes do.

A. EDWARD RHODES.

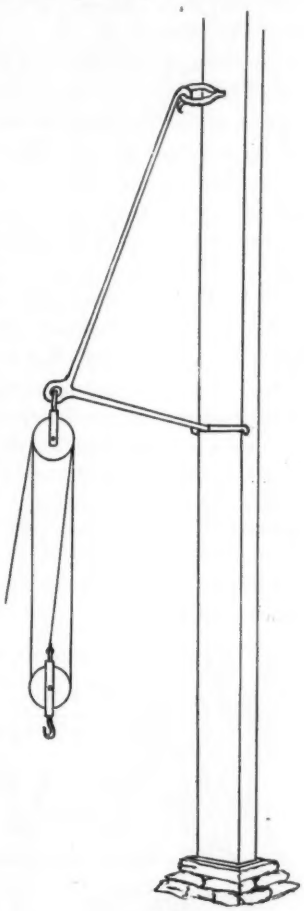


Fig. 1.

Furnace and Draft

Editor PRACTICAL ENGINEER:

In the construction of the furnace of a steam boiler there are certain conditions that must conform if high efficiency is desired; some of them depend upon the requirements for good combustion, and some upon the skill and endurance of the fireman, where hand-firing is employed.

The furnace should be constructed inin such a manner that an abundant and uniform supply of air is supplied to the under side of the grates, and also allow means for the admission of air over the top of the burning fuel.

In the majority of furnaces, it is undoubtedly a fact that they call for a greater amount of repair and labor than any other item of maintenance in the boiler room. This is owing to the fact that from the moment a fire is started the furnace begins to deteriorate, because it is subjected to a very high degree of heat constantly, and which is not uniform in its intensity. The arches, cheeks and lining, are exposed to the intense heat of the incandescent coal and burning gases, while the grates are exposed to the under heat of the burning fuel.

The effect on the furnace is to cause the brick work to burn and crack, and if not repaired will allow of admission of air which is a source of loss, as it injures the draft and reduces the temperature of the products of combustion. This applies to externally fixed boilers. The grates should not be of such length or width that the fireman cannot conveniently reach all parts in handling the fuel, and in the cleaning of the fires; for hand firing they should not be over six feet long, and if over four feet wide, two doors should be provided, which should be placed about two feet from the floor, if the convenience of the fireman is to be taken into consideration.

Grate bars are commonly made of cast iron and are about as durable as those made of wrought iron. Ordinarily, they are laid lengthwise of the furnace, being more easily cleaned in this position than as if arranged crosswise. Their length should not exceed their feet; when the furnace is of a greater length, the grate is divided into two or three short lengths, designed according to the demands of the fuel to be burned. The requirements of grate bars are, that they be of such shape that they will not warp under the heat of the furnace, that they will be easy to remove, and cheaply made.

The openings, or air spaces, vary according to the requirements, from $\frac{1}{4}$ inch to 1 inch in width. The type of grate known as the "herring bone" has proved a popular one, and is used extensively. The introduction of the rocking grate has resulted in an improvement in furnace economy that has been appreciated by all who have used them, as they allow of the breaking up of the clinkers, so that they fall through the grates into the ashpit. This enables the fireman to keep clean fires, and thus prevents the frequent opening of the furnace doors, for the purpose of breaking up the fires, and cleaning the ashes from the grates.

A matter that has become of great importance is that of smoke prevention, especially in cities where much soft coal is used. Smoke may be practically prevented, but in some instances at a loss. The saving in preventing the loss of the volatile parts of coal is not enough to induce some coal consumers to take means to prevent the formation of smoke; and in cases where the law forces the abatement of smoke, other fires have often been adopted in preference to installing a smoke consumer.

Many improvements have of late years been made in connection with the economy of the furnace, such as the down-draft system, mechanical stokers, oil burning arrangements, economizers, and height, style and size of chiimneys.

Of the last mentioned, considerable may be said, although our knowledge of chimneys and chimney draft is far from satisfactory. The theory of the chimney draft is that it is produced because the gases inside the chimney are hotter and consequently lighter than the outside air, which naturally

makes the pressure in the chimney a little less than the pressure of the outside air, with the consequence that the air will flow from a point of higher pressure to a point of lower pressure, or from the outside air to the chimney through the grates.

With the height of the chimney, the temperature of the hot chimney gases and the outer air known, the draft pressure may be found by the following forumla:

$$P = C\left(\frac{7.6}{T} - \frac{7.6}{Ta}\right)$$

in which P. equals draft pressure in inches in water; C. equals height of chimney; T equals absolute temperature of air, and T. A. equals absolute temperature of gases; the the absolute pressure being found by adding 460 degrees to the ordinary temperature. For instance, take air at a temperature of 60 degrees, the absolute temperature is 460 x 60 x 520 degrees. Assuming that a chimney is 130 feet high, that the hot gasses have a temperature of 580 deg. F. and the external air is 60 deg. F. Using the above formula, we have:—C—130 ft. height of chimney; T x 460—60, absolute temperature of the air; TA—460 — 580, absolute temperature of the gases; or, 130 $\left(\frac{7.6}{460+60} - \frac{7.6}{460+580}\right) = .949$ inches of water if a **U** tube was used.

One theory is that the temperature of the chimney should not exceed 600 deg. F., or the melting point of lead. There are many chimneys, however, that are working satisfactorily at about this temperature, which should be sufficient to produce all the draft required, but this chimney temperature should be lower, as the hotter the escaping gases, the greater the number of heat units lost. It is therefore, desirable to prevent high chimney temperature, and still maintain a good chimney draft.

I. M. Spry.

QUESTIONS and ANSWERS

THE editor will be glad to receive from the readers of THE PRACTICAL ENGINEER, such questions relating to engineering subjects, as may, from time to time, occur to them. All questions and answers should be addressed to the editor and accompanied by the name and address of the writer, which will not be published, however, unless especially desired. It is the intention that questions shall be answered by the readers, and even though the editor may, from time to time, publish answers and questions, he especially desires the readers in such cases to contribute any further information, in connection with the points raised, that they may consider of interest. All questions and answers received by the editor will be published, as far as practicable, but he reserves the right of editing or rejecting any communication.

Editor Practical Engineer:

Will you please answer through your columns the following questions:

1st. Why can a suction pump at the bottom of a deep mine lift water higher than a pump at the surface?

2nd. What do you understand by a direct acting steam pump?

3rd. In a Worthington slide-valve duplex pump how is steam retained in the cylinder to form a compression for the piston?

4th. How do the dash relief valves control the length of the stroke?

5th. What are the dash relief valves?

6th. What is the purpose of the so-called cross-exhaust connection in compound direct acting steam pumps?

7th. How are the cranks of double acting power pumps set so as to give a steady flow of water?

8th. What is meant by the under deck of a pump?

9th. Describe the method used in setting the valves in a duplex pump.

Wilmington, Del.

W. J. J.

1st. The pump does not lift the water out of the mine but pushes it out. No pump will lift water over (about) 30 feet, but it is no trouble to push the water almost any distance.

2nd. A direct acting pump is one with the pump piston and power piston in one direct shaft or plunger.

3rd. You will notice in figure one that at each end of the cylinder there are two ports, the exhaust ports being those two nearest the center of the cylinder. Now in process of making the stroke the piston closes this port before it reaches the end of the stroke, leaving the balance of the stroke to make a compression. This action is of course at either end of the stroke.

4th. and 5th. Answer to these will be found contained in the answer to question No. 9.

6th. The cross exhaust connection is compound direct acting pumps is to carry the steam from the high pressure cylinder to the low pressure cylinder, where the expansion takes place, the steam acting at full boiler pressure throughout the stroke on the high pressure end. It is attached as a cross connection in a manner to facilitate access to either end and so that it can be connected or disconnected without disturbing any other parts of the pump.

7th. The cranks of a double acting pump are set on the quarter stroke in order to maintain a steady flow of water.

8th. We do not know what is meant by the question.

9th. A duplex pump is simply two pumps of the same size side by side. The pistons do not travel in unison, but one is 90° ahead of the other. That is to say, when one piston is at the end of the stroke the other piston is at the middle of its stroke. This affords a means of dispensing with the auxiliary piston and movable seat, used on single pumps, by obtaining the motion of each valve from the opposite piston.. We have two different styles of duplex pumps operating on this principle, shown in Figs. 1 and 2.

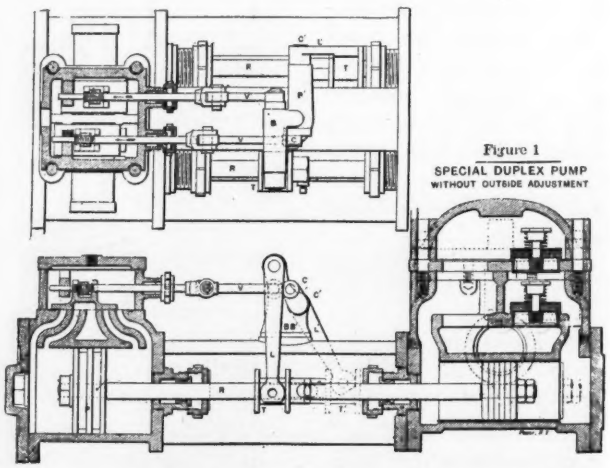


Figure 1
SPECIAL DUPLEX PUMP
WITHOUT OUTSIDE ADJUSTMENT

The duplex pump without outside adjustment is shown in Fig. 1. The manner in which the motion of each valve is derived from the opposite piston is as follows: The piston P,' not shown in the cut, which carries the piston R', is now at the left-hand end of its stroke and begins to move to the right.

The rod R' carries the collar T' and this collar, when it moves to the left, will rotate the lever L' about the shaft C'. This shaft extends through the bearing B', and at its other end carries the crank C, which is attached to the valve rod V. The lever or rock shaft reverses the motion given to it, so that when R' moves to the left, the valve attached to V will move to the

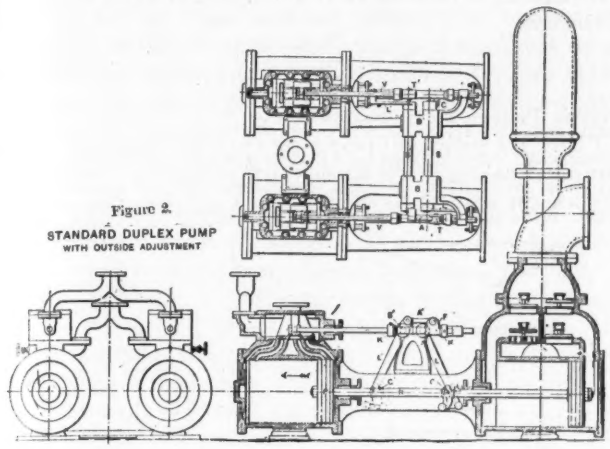


Figure 2.
STANDARD DUPLEX PUMP
WITH OUTSIDE ADJUSTMENT

right. When the lever L' is perpendicular the valve will be central. The rod R carries another collar T, which engages the lever L, whose shaft passes through the bearing B and operates the valve rod V'. Thus each valve is driven by the opposite piston. It will be seen that when one piston is central, as shown by the perpendicular position of the lever L, the other piston is at the end of its stroke, as shown by the extreme position of the collar T'. This obviates the necessity of any device for throwing the valve, and renders it possible to use the plain slide, as shown. Because it is obvious that the piston P will continue to move to the left, as the right-hand port is wide open to steam, and this will carry the valve of the other cylinder beyond the central position

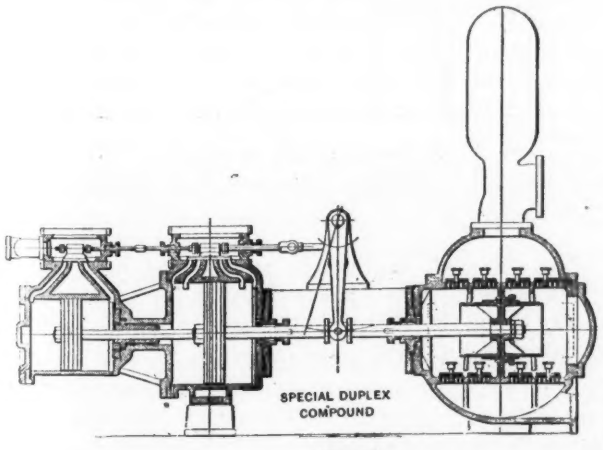


Figure 3.

There is no outside adjustment for the steam valves in this pump, but the valve rod is threaded at the point where it passes through the steam valve, and the position of the steam valve may be altered by rotating the valve rod, after first disconnecting the link connecting the valve rod with the lever. The valve setting is accomplished by first removing the covers of the steam chest, moving one piston over to the extreme end of its stroke on one end, and noting the position of the steam valve on the opposite side of the pump; that is, the amount of opening of the steam port. Then the piston should be moved over to the other end of stroke, and the amount of opening of the steam port again measured. In case the openings at the two ends are equal, the valve is set correctly. If not, the position of the valve on the valve rod must be altered as indicated in the preceding paragraph until the two openings are equal. Then the same process must be repeated for the other side of the pump. In every case the manipulation is with one piston and the opposite valve.

In order to obtain the outside adjustment, a slightly different method of moving the valves is employed. The same general idea of a rock shaft is noticeable, but the crossheads T T', Fig. 2, on the piston rods, are provided with short links to allow for the movement of the levers L and L', instead of the slot arrangement shown in Fig. 1. The communication to the valve rods is by means of tappets which slide on the rods and move the valves when they strike the collars.

Referring to Fig. 2, the piston P is at its right-hand end of its stroke and the other piston, P_0 is at the left hand side of its stroke. Now, P' starts to the right, carrying with it the crosshead C', thus turning the rockshaft S', whose bearings are in B. and B'. The upper end of the rockshaft then moves to the left, carrying with it the tappet arm A', attached to the tappet T. The tappet slides along the valve rod until it strikes the collar K', when it carries the valve rod over to the left, thus admitting steam behind P. This occurs when P' is nearly at the end of its stroke. Then P starts to the left, and by means of the other lever, rockshaft and tappet, actuates the valve of the other cylinder. There is, therefore, no dead centre for the valves when properly set.

To set the valves of one of the pumps shown in Fig.2, the steamchest covers must be removed. The steam piston of one side should be moved to the extreme end of its stroke at one end, and the steam valve of the opposite cylinder placed so that the outside edge of the valve is flush with the inside edge of the steam port; that is, the port is wide open to steam. At the same time the collar of the valve rod on the second cylinder must be in contact with the sliding tappet.

Next, the first piston must be moved to the opposite extreme of its stroke and the position of the valve adjusted by means of the valve rod collar, so that the steam port of the second is just wide open.

The valve on the second cylinder is now set correctly, and the first valve in the same way.

This method insures the fact that travel of the valves on each side of the centre of the steam chest will be the same on each stroke; but it does not insure the fact that the pump shall make full stroke. If the stroke is too short, the collar should be set further apart by turning them around in the thread provided. Care must be taken to turn all collars the same number of turns or parts of a turn, as otherwise the stroke will be longer on one end than the other. If the stroke is too long, the valve rod collars should be brought nearer together. This adjustment can be performed at any time, whether the pump is in operation or not.

The advantage of securing full stroke lies in the reduction of the clearance space, thereby lessening the am unt of steam wasted on each stroke.

Compound Duplex Pump

This is shown in Fig. 3 with the valves in the middle position The valves having no outside lap, the steam follows full stroke, and the engine is therefore of the Wolff type, in which all the expansion occurs in the second cylinder.

The valve gear here is similar to that shown in Fig. 1, and the valve setting differs in no way from that of the one in that figure. Of course due care must be taken to have the distance between the steam valves correspond to the distance between centres of the high and low pressure steam chests.

Compound duplex pumps are also made with the same general valve gear arrangement shown in Fig. 2, and therefore possess the same advantage of an adjustable stroke.

EDITOR PRACTICAL ENGINEER.

Will you please give me some information about safety valves. I have a safety valve on my boiler which acts in a manner I cannot understand. If I set it to blow off at 90 pounds it will not blow without raising it completely off its seat by means of a rope and pully. When it finally does start to blow it will not stop until the steam pressure drops to 70 pounds. However, if I go on top of the boiler and push it down it will hold at the pressure set.

FRANK MARTINELLI.

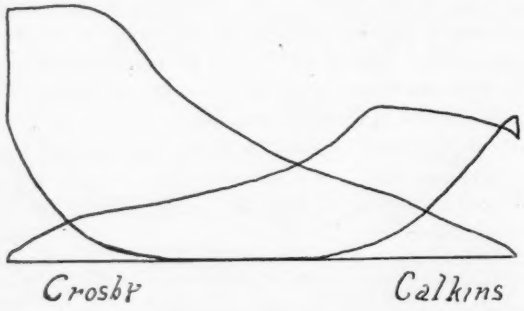
The reader is referred to an article on Safety Valves appearing elsewhere in this edition of "The PRACTICAL ENGINEER".

EDITOR.

EDITOR PRACTICAL ENGINEER:—

Enclosed you will find a diagram taken from a fore and aft Hodge compound engine with wheel governor built by Hodge of Detroit, Mich. At this plant there is two engineers, one says, "that the valves are not set right," and the other says, "that the steam blows through the piston." Who is correct?

L. F. G. MICH.



Both are right in a measure. 1st. the valves on the right hand card are not correct, the steam admission takes place too late. It will be noticed that the compression line runs up properly, but instead of taking steam the line drops quite a little before steam admission takes place—admission should be earlier. 2nd, in reference to blowing through the card shows one of two things—either steam blows through the exhaust valves on one side, thus preventing the steam line from raising, or else the steam valve is loose, thus preventing a full admission. We would also advise you to take both cards with the same indicator and not one end with a Crosby, and the other with a Calkim.

There is often a difference in indicators.

EDITOR.

EDITOR PRACTICAL ENGINEER:—

Will you please tell me the way to run dampers in the fire doors—open or shut—on a 200 horse-power boiler?

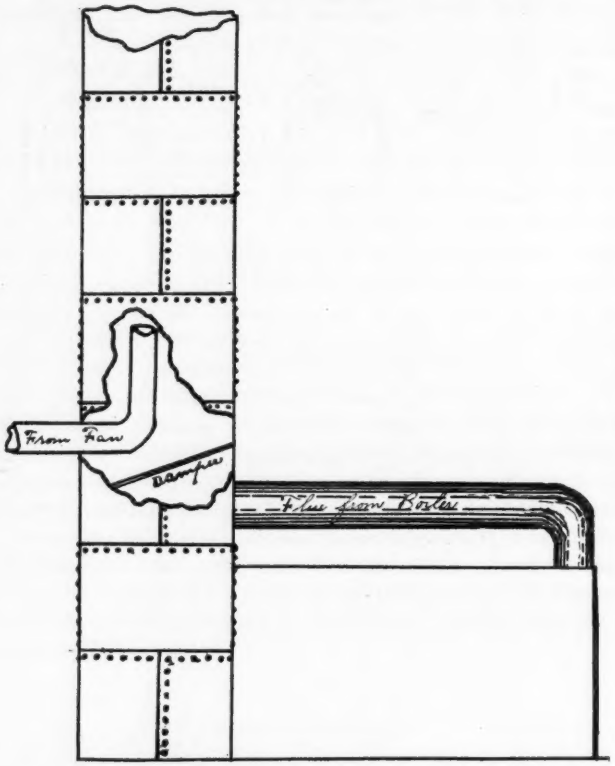
O. S. GAYTARD.

This question will be found fully answered in an article entitled "Air Supply to the Furnace," appearing in the June, 1903, number of the PRACTICAL ENGINEER, to which the reader is referred.

EDITOR.

EDITOR PRACTICAL ENGINEER:—

I have not sufficient draught for the coal (rice coal) I am using, and, having an idle fan here, it occured to me that I might increase the draught by running, say a 4 or 5 in. pipe into the



stack above the damper as shown in sketch. Having some doubt about it I concluded to ask you. Your opinion upon this will be appreciated.

FRANK ROSE.

There is no doubt but that you will be benefited by applying the fan as indicated in your sketch, but it is considered better practice to run the air shaft in through the ash-pit doors, thus delivering the air direct to the furnace.

EDITOR.

EDITOR PRACTICAL ENGINEER:—

In regard to the question about right or left-handed engines. In your answere to "J. P. L.," in your number of June, you state; If "J. P. L." will kindly inform us of any right-hand or left-hand engine in which the crank and the fly wheel (if there is one) do not lie on the same side of the centre line of the cylinder, he will bring to light a remarkable mechanical curiosity." Such a "curiosity" exists in the "metropolitan" horizontal

self-contained engines, of which we have one running at our place. Very likely some of your readers will be able to contribute instances of this kind.

PHILADELPHIA. C. B. HARDENBERG.

EDITOR PRACTICAL ENGINEER.

I would be pleased to have you publish this in your columns, in order that I may have the opinions of my brother engineers upon the subjects mentioned. A month ago I took charge of a Buckeye engine and have had trouble of varied types ever since with the engine. When the engine is running under full load it works as steady as could be desired except that there is a clicking noise, apparently emanating from the steam chest.

When running under no load the cut-off rod and eccentric will give sudden jumps and then will almost stop. However, this does not vary the speed of the engine, and it occurs about every eight or ten revolutions and continues for about three or four revolutions. When the engine is slowed up the clinking noise ceases. I have consulted an expert engineer, but with no beneficial result.

Please explain how to set the valves of a Buckeye engine?

How do you define the difference between a series wound, and a compound wound dynamo? CONSTANT READER.

Safety-Valves

The form and construction of this indespensable adjunct to the steam boiler are of the highest importance, not only for the preservation of life and property, which would, in the absence of that means of "safety" be constantly jeopardized, but also to secure the durability of the steam-boiler itself. And yet, judging from the manner in which many things called safety-valves have been constructed of late years, it would appear that the true principle by which safety is sought to be secured by this most valuable adjusct is either not well understood or it is disregarded by many engineers and boiler makers.

Boiler explosions have in many cases occurred when, to all appearances, the safety-valves attached have been in good working order; and coroners' juries have not unfrequently been puzzled, and sometimes guided to erroneous verdicts by scientific evidence adduced before them, tending to show that nothing was wrong with the safety-valves, and that the devastating catastrophies could not have resulted from over-pressure, because in such case the safety-valve would have prevented them. It is supposed that a gradually increasing pressure can never take place if the safety-valve is rightly proportioned and in good working order. Upon this assumption, universally acquiesced in, when there is no accountable cause, explosions are attributed to the "sticking" of the valves, or to "bent" valve stems, or inoperative valve springs. As the safety valve is the sole reliance, in case of neglect or inattention on the part of the engineer or fireman, it is important to examine its mode of operating closely. Safety-valves are usually provided with a spring or guide-pin, attached to the underside, and passing through a cross-bar within the boiler, directly under the seating mechanism of the valve. Now, it is certain that if this guide-pin becomes bent from careless handling the safety-valve may be rendered almost inoperative, and uncertain of releasing the pressure at the point indicated. It will then allow only a small aperture for the escape of the steam, and, further, it will not return perfectly to its seat; hence, a leaky valve is the result, and to overcome this difficulty, ignorant engineers and firemen generally resort to extra weighting; and it is not uncommon to find double or treble the weight corresponding to the pressure required in the boiler. Another difficulty is that the safety-valve levers sometimes get bent, and the weight, consequently, hangs on one side of the true center; this, it will be seen, causes the valve to rest more heavily on one side than the other, and the greater the added weight the greater the difficulty. The seats of safety should be examined frequently to see that no corrosion has commenced; as valves, especially if leaky, become corroded and often stick fast, so that no little force is required to raise them. If, when a safety-valve is properly weighted, it should be found leaking, do not put on extra weights, but immediately make an examination, and in all probabilty the seat or guide-pin will be found corroded, or there will be foreign matters between the valve and its seat. By taking the lever in the hand and raising it from its seat a few times, any substance that may have kept it from its seat will be dislodged; or it may turn out on examination that the lever had deviated from some cause from a true center. Such difficulties can be easily righted, but extra weight should never be added, as it only aggravates the trouble instead of remedying it. When the weight of the safety-valve is set on the lever at safe working pressure, or at the distance from the fulcrum necessary to maintain the pressure required to work the engine, any extra length of lever should then be cut off as a precaution, to prevent the moving out of the weight on the lever, for the purpose of increasing the pressure, as, while the lever remains sufficiently long, the weight can be increased to a dangerous extent without attracting any attention; while if the lever is cut off at the point at which the safe working pressure is designated, any extra increase of pressure can only be accomplished by adding more weight to the lever, which is tolerably sure to attract the attention of some one interested in the preservation of the lives and property of persons in the immediate vicinity.

The bolts that form the connection between the lever, fulcrum and valve-stem should be made of brass, in order to prevent possibility of corrosion, "sticking" or becoming magnetized, as it is termed; and for the same reason, the valve and seat should be made of two different metals. When safety-valves become leaky they should be taken out and reground on their seats, for which purpose pulverized glass, flour of emery, or the fine grit of mud from grinding stone troughs are the most suitable material; but whether they leak or not, they should be taken apart at least once a year and all the working parts cleaned, oiled and readjusted. The safety-valve is designed on the assumption that it will rise from its seat under the statical pressure in the boiler, when this pressure exceeds the exterior pressure on the valve, and that it will remain off its seat sufficiently far to permit all the steam which the boiler can produce to escape around the edges of the valve. The problem then to be solved is: What amount of opening is necessary for the free escape of the steam from the boiler under a given pressure? The area of a safety-valve is generally determined from formulæ based on the velocity of the flow of steam under different pressure, or upon the result of experience made to ascertain the area necessary for the escape of all the steam a boiler could produce under a given pressure. But as the fact is now generally recognized by engineers that valves do not rise appreciably from their seats under varying pressures, it is of importance that in practice the outlets round their edges should be greater than those based on theoretical condsiderations.

Thawing out frozen water service pipes by electric heat,—something that was done several times during the past winter—is one of the latest accomplishments in applied electricity. The usual plumbers' methods of thawing out pipes are exasperating, if nothing worse, and the electric idea, which, by the way, appears to have been worked out simultaneously in several different places, comes to us, therefore, with the pleasing recommendation of neatness, dispatch, and effectiveness. With it excavating streets or grounds outside of buildings is not necessary. The operation consists in uncovering the service pipe after entering the building and cutting the pipe in two, so that electrically the water-pipe system of the building is cut out of circuit. Alternating current has been employed.

The Southwick Automatic Return Steam Trap

The demand for a means of returning the condensed steam to the boiler from heating apparatus, such as may be found in almost any plant, is constantly increasing, and to meet this demand a multiplicity of devices have been patented, all of more or less value.

The requirements for an article of this kind are for a device which shall require as little attention as possible, that is not readily affected by change of temperature or pressure, with as few working parts as possible, and so constructed as to be easily and cheaply repaired. In many cases these features have been entirely overlooked in the making of return traps. Duplex pumps with automatic receivers have been most extensively used for this purpose.

The engravings shown in this article illustrate an improved form of Return Trap, in which the inventor has endeavored to overcome the objections heretofore raised to Traps for returning water of condensation back to the boiler. In this Trap ample power is afforded to operate the flat slide valve, which is

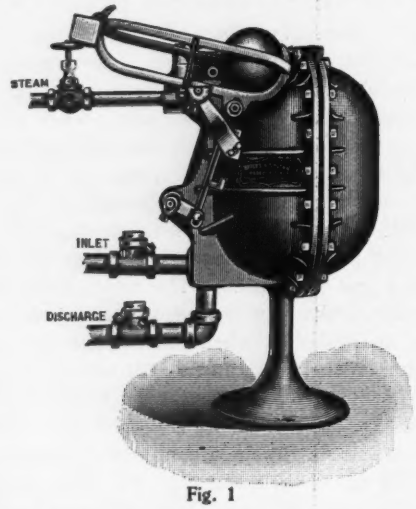


Fig. 1

given sufficient lap so that with boiler pressure against it, it will remain tight for a long time. Provision is also made for easy access to the valve without disturbing the connections.

No trap will work well with a leaky steam valve, which has been one of the principal causes of failure of return steam traps. There has been little available power to operate the steam valve, therefore the valve was necessarily small and very delicate, with little lap.

By referring to the cuts the reader will readily understand the method of operation. Fig. 1 shows the outside view. Fig. 2 shows valve and seat removed, and also back to remove the float.

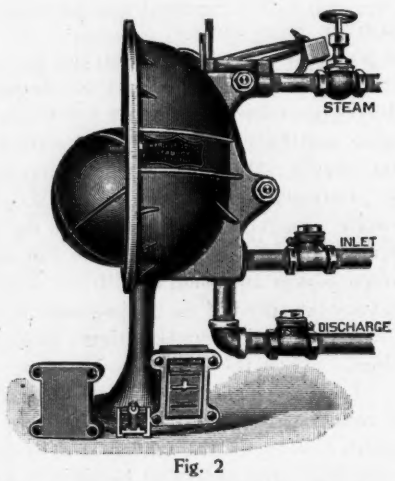


Fig. 2

In operation the receiver is placed below the lowest coil from which condensation is to be returned, therefore condensation will flow to receiver by gravity. From receiver it passes up the center pipe to trap. As the body of trap fills, the float raises, which tilts cradle and raises ball. When trap is full cradle has raised ball sufficient to cause ball to roll to other end of cradle, which opens steam valve and lets boiler pressure on top of water which flows through discharge pipe to boiler. The check valve on inlet pipe prevents water from returning to receiver. As the water lowers in trap the float drops with it and tips cradle with ball, which rolls to opposite end (to position shown in cut) which shuts off steam from trap and opens vent, which allows pressure to drop in trap and water fill again enter from receiver. If there is considerable condensation, trap will fill quickly, but if there is little it will be a long time filling.

Futher information and futher details as to this device may be obtained from the selling agents, Messrs. John S. Bushnell & Co., 126 Liberty Street, New York, N. Y.

The Improved Bonar Oil Filter

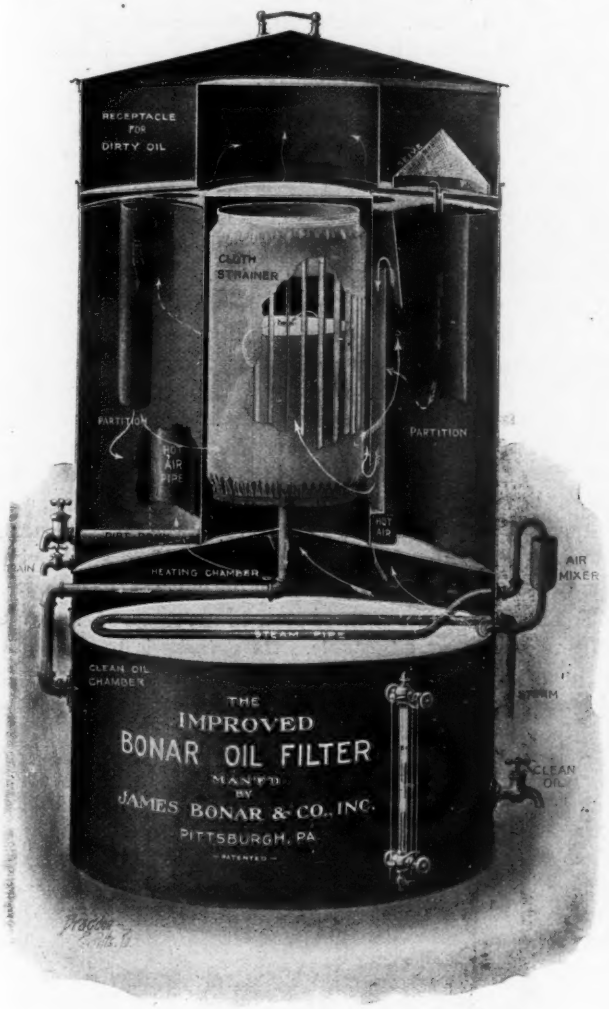
Engineers and manufacturers are daily becoming aquainted with the fact that great economy is obtained in filtering and reusing the oil often permitted to go to waste. In the recovery of this oil there is often used devices of intricate and cumbersome shape, which is unnecessary as there are appliances manufactured of the most effective yet simplest type, as the following description of the Improved Bonar Filter will indicate.

The impure oil is emptied into the receptacle on the upper part of the filter, passing from there through a conical sieve. The construction of this sieve prevents any matter from collecting on it, and may be readily cleaned off without clogging it up, as is the case with the inverted type of sieve.

After passing through the sieve the oil is conveyed to a low point in the chamber, on the other side of the partition shown in right hand of cut, then passing around the outer half of the chamber where it meets the other partition passing through it by means of a skimming device, from thence to the other partition where it again passes through a skimming device to the inner chamber.

In this chamber is a patented cloth filtration and separating chamber, composed of a galvanized iron cylinder on which is arranged a series of ribs, covered with special filtration cloth. As will be seen from cut the oil passes through the cloth from the outside, up between the ribs to the opening in center and thence by pipe to the clean oil chamber underneath the heating chamber.

The heat is introduced by a small steam pipe into the heating chamber, underneath the filtration chamber. This pipe passes in and around and out, where it is connected with an air mixer passing again into the heating chamber mixed with air. This method of introducting the steam prevents the temperature



from rising above the boiling point, and keeps the oil at a uniform temperature at all times. In the upper part of this heating chamber is arranged a series of heat conducting pipes passing up through the filtration compartments, imparting a uniform temperature to the oil in course of filtration.

It is an easy matter to clean the filter and renew the cloth by merely lifting out the inner cylinder, taking off the old cloth and tying on a new one. Drain spigots are arranged on the inner and outer filtration compartments.

Further description may be had by addressing James Bonar and Company, 1717 Frick Building, Pittsburg, Pa.

The Victor Low Pressure Steam Trap

A new steam trap especially designed for low pressure service has just been brought out by the Wright Manufacturing Company, of Detroit, Mich. As is generally known, such service requires extremely large valve area in a steam trap, owing to the large quantities of condensation which the trap is called upon to handle. By noting the accompanying sectional illustration it will be seen that this requirement is well-provided for in the "Victor" by a valve whose area is approximately equal to that of the pipe at inlet and outlet, thereby assuring immense dis-

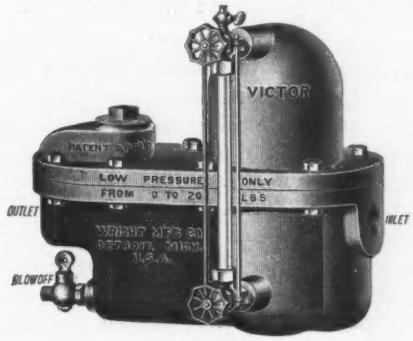


Fig. 1

charging capacity. By way of example the smallest size of the victor steam trap is capable of discharging 350 gallons of condensation per hour, and the largest size 8000 gallons per hour, at a steam pressure of three pounds in both instances. There are seven intermediate sizes, making nine sizes in all.

Next to its great capacity, the other novel feature in the Victor steam trap is found in its ability to operate under no steam pressure whatever, the pressure of the incoming condensation being alone sufficient to open the valve. The extra pressure at which these traps are intended to operate is 20 pounds.

In operation the Victor trap is very simple. The condensation enters the trap, filling it to the level of the valve, when the float is raised by the incoming condensation. At the same time the valve is floated, or lifted, from its seat. The trap then

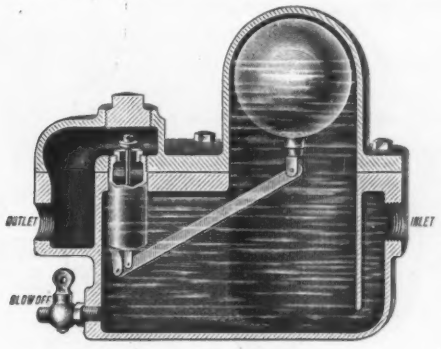


Fig. 2

delivers the condensation, continuing to discharge until the inflow of condensation ceases, when the float, in descending, closes the valve.

The other features of this trap may be briefly summarized. A deep water seal covers both inlet and outlet, preventing leakage of steam. The blow-off serves to keep the trap free from sediment, although the latter could hardly interfere with the working of valve, owing both to its large size and its location near the top of the trap. A water gauge is also provided, to

which an air valve is attached for venting the air when the trap is working under very low pressure. The valve and valve seats which are constructed of the best steam jet metal, may be removed with a screw-driver and wrench. As the working parts are attached to the cap they may be removed without disturbing the piping. The float is round and seamless.

The manufacturers will be pleased to send one or more of them to any responsible concern, subject to 30 days' approval test, and will pay the freight charges both ways in case of dissatisfaction. Full particulars may be had by addressing the Wright Manufacturing Co., 72 Woodbridge St., Detroit.

The St. John Self-Adjustable Cylinder Packing

One of the important features of steam engineering often given too little consideration is engine friction. Many engineers deem it sufficient if the engine runs smoothly, not giving a thought to the amount of pressure required to drive the engine, irrespective of load; yet a difference of ten pounds of steam in the friction load is exactly the same as a corresponding change in boiler pressure. Thus it becomes obvious that the utmost care should be exercised in noting the frictional resistance in an engine, and in using packing rings guaranteeing tight joints with minimum friction.

In considering this subject one will be interested in the following description of the St. John Self-Adjustable Cylinder Packing, manufactured by H. B. Underwood & Co., 1025 Hamilton St., Philadelphia, Pa.

The St. John Self-Adjustable Cylinder Packing is one of the greatest achievements in ecomomy of steam in the steam-engine that has been developed within the past twenty years. Though forming but a minor part in the construction of an engine, it gives to that engine greater vitality and power than is usually secured by the use of cylinder packings, for the reason that it absolutely prevents the loss of a particle of steam entering the cylinder, and gives to the piston easier and truer action with little or no friction or effort. In other words, every cubic inch of steam entering a cylinder is utilized to its fullest extent; actual practical use of the St. John Packing in hundreds of cylinders since the first patent was granted in 1881 has demonstrated this.

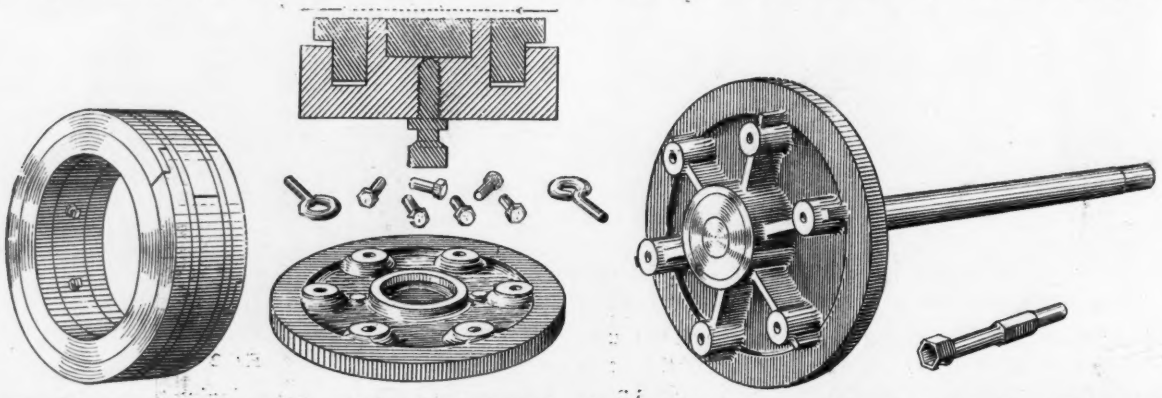
It fits tightly, and yet reduces the friction in the cylinder. While these two statements may seem contradictory of each other, a trial will show them to be perfectly consistent; and the proof is in the fact that this packing is self-adjusting. By the very power that moves tde piston, the packing is spread evenly against the cylinder it moves in; and because it is thus evenly distributed there is no wabbling motion, but it traverses the cylinder with a smooth, steady movement. It is, therefore, a saving to use it, because both the cylinder and piston, and, indeed the engine itself will last longer in consequence of this "true motion"

By its self-adjusting power it is capable of filling a much larger space than it is necessary to give it, and there is, therefore, no room for the escape of steam through it or between it and the cylinder. In whatever part of the latter it may be, it fills the entire space, and is, therefore, absolutely steam tight, and will continue so to be as long as it is in use. This is a strong point for the consideration of engineers; for all such know that a leaky piston causes a great waste of steam, and hence a great waste of power. That means also a great waste of fuel. More power is acquired with less fuel, because none of the steam going into the cylinder is allowed to pass away until it has done the duty for which it was generated.

Another source of the increase of the power acquired by it is in the more perfect vacuum it makes. That renders it unnecessary to carry as much steam as with the old style of packing; and with the same head of steam the engine will be driven faster than with the old style. All this is plain to the practical mechanic, who knows as well as the scientific man that wasted energy brings no profit but loss of power.

A general view of the Packing is shown in the illustration. The two L shaped rings are fitted in grooves in the bull ring, and are quite elastic, being set out against the walls of cylinder by steam. The proportions are so nicely made, and the pressure of the steam sets them so gently that scarcely any wear takes place, and they are perfectly steam tight. Friction being reduced to a minimum, no cutting of the cylinder surface ever takes place. The centre ring is fitted into the bull ring, and is adjusted by the set screws so as to carry the piston central, and hold it steady thereby, relieving the steam rings, and leaving them free to act upon every portion of the circle of the cylinder.

The packing consists of three parts in the shape of rings, the centre of one being adjustable. Its purpose is to carry the weight of the piston and to steady the motion of the latter,—an indespensible requisite in all engines. The outer, or steam



rings, are fitted on the centre, one at each side. They constitute the packing, and are readily expanded by the steam pressure to fit the cylinder. When the piston moves forward, the steam fills the grooves in the rear outer ring, expanding it in all directions to the full diameter of the cylinder; when the piston returns, the forward outer ring is acted on in the same way by the steam behind it. Consequently, the pressure of the cylinder comes from only one of these outer rings at each motion of the piston rod, and there is no friction at any other part of the packing.

Society News

American Order of Steam Engineers

New Officers of Lehigh

Lehigh Council 15 of Allentown, Pa., the third largest council in the A. O. S. E., still continues to prosper, and is taking in new members right along. Secretary A. P. Dreisback sends us the following list of new elected officers for the term commencing July 1st:

Past Chief Engineer, John Durrin; Chief Engineer, Henry C. Snyder; First Assistant Engineer, John T. Lindstrom; Recording Engineer, A. J. Strauss; Financial Engineer, Jacob Donnecker; Corresponding Engineer, A. P. Dreisback, 728 Chew St., Treasurer, John Burley; Chaplain, John Kromer; Senior M. M., Jessie Williams; Junior M. M., Hiram Roth; Inside Sentinel, Alfred Geary; Outside Sentinel, Edmund Brader; Trustee A. J. Strauss.

The 14th Anniversary of Southwark Council

The fame achieved by Southwark Council at their grand entertainment given in Odd Fellows Temple last December, at which there were delegations from some half dozen states, had so aroused the envy of the members' wives that the Southwark boys were put to a test of gallantry to devise means for entertaining the ladies. This they did in good style on the evening of May 28th, which was the 14th anniversary of the Council.

The entertainment consisted of a concert and ball for members and their families only. The programme for the evening was in three parts. First, a concert by a troup of sketch artists and other professional entertainers. The concert was enjoyed by both old and young. The second part was refreshments which were served in the lower hall., while the upper hall was being prepared for the ball which followed, and it was here that the real fun commenced.

The following brothers and their wives lead off with an old fashioned cotillion: Frank Moore, Joe Calloway, Jas. Devlin, Jas. McDowell, Pop Conner, D. V. Harrington, Frank Waner, Alex Palmer and Gus Hummell—and what fun for the youngsters to see the old folks dance. Here are some of the side remarks by the young ones that were overheard: 'Why' just look at Pop, he's getting Mom all tangled up in that set." "Would you get onto Mr. Calloway, why he almost kicked your mother's head off." "Why, I didn't know Pop could dance so well," and some not so complimentary. But the worst was when Jim Holland said, that McDowell moved through the set like a brick house." McDowell says he was jealous, or envious of the good showing made by the McDowell family, which was all together for the first time in five years, and just to celebrate the occasion the son Jimmy and the eldest daughter proved themselves the best dancers in the room.

Altogether, it was the most enjoyable affair ever given by the Council, and the ladies enjoyed it immensly, so much so that the "boys" were permitted to attend another stag affair—a euchre party—given by the Merrick Association, N. A. S. E., on the following Monday evening, without protest.

A Pleasant Evening with Merrick Association

Merrick Association 12, N. A. S. E., of Philadelphia, gave a progressive euchre party at their rooms, at 8th and Spring Garden Streets, on Monday evening, June first, to which all engineers associations of the city were invited. The rooms were crowded to their utmost capacity and the evening was spent in a most delightful manner. Southwark Council, of the A. O. S. E., arrived in a body, and there were good delegations from every engineer's organization in town.

President Jas. D. Lynch presided, and after welcoming the visitors, a good number of those present turned in to play progressive euchre, but Mr. Caldwell says it didn't progress very far, for there were too many other things to interest them—perhaps it was the refreshments, which were abundant and excellent. In any event the boys enjoyed themselves thoroughly.

There were speeches by the representatives of each organization—some good ones too—and the affair has doubtless done much toward uniting the engineers of Philadelphia for more concerted action in the interest of their profession.

Banqueted by Engineers

The Allied Engineers License Committee of Philadelphia gave a testimonial banquet to the Honorable Joseph MacIver, member of the Pennsylvania Legislature, on Tuesday evening, June 2nd, in recognition of his services in having the Philadelphia Engineers License Law amended by the last Legislature. The banquet was given at Taggs Mannaerchor Garden and was attended by more than 150 engineers. Mr. Chas. Snyder, of Merrick Association, made an agreeable and efficient toastmaster, and in a brief but effective speech, paid handsome tribute to the guest of honor for his accomplishments in connection with the passage of the original License Law, and also with the recent amendment. Speeches were also made by Chief Boiler Inspector, John M. Lukens, John Rickards, F. R. Moore, C. P. Williams, Frank Mellor, and others, all praising Mr. MacIver and assuring him of the sincere appreciation of the engineers of the city for his good work in their behalf. Toastmaster Snyder then rose, and, with a neat speech on behalf of the engineers represented by the Allied Committee, presented Mr. MacIver with a handsome diamond ring, as an additional and more durable token of their appreciation.

A Love Feast at Maryland Council

EDITOR PRACTICAL ENGINEER:—

At the meeting at Maryland Council 1, of Baltimore, on the 29th of May, when it was announced that brother Noah Pierson of this council had been elected Supreme Chief Engineer of the A, O. S. E., the members had an old time love feast; it being the first time that the Supreme Chief of the Order has ever been a Maryland man.

Brother A. Bichell presented the new Supreme Chief with a large bunch of American Beauty roses; he also presented Brother Al. Deitrich with a bunch, but, as brother Deitrich is not as large as the Supreme Chief, his bouquet was not so large. Brother Pierson responded with a large speech and Brother Deitrich with a nice little one.

After the Council was called to order by the Chief Engineer, our new Supreme Chief gave us a talk urging us to advance the interests of our Council and our Order in every way possible. He also told us that it was his desire that every member of this Council and of all others councils in the Order should subscribe regularly for "The Practical Engineer."

When the Supreme Chief was through talking, a number of members handed Bro. Schrier their subscription.

W. S. Smith, Secy.

TRADE NOTES

"Metallic Packings" is the title of a paper by Charles Longstreth, read before the American Society of Naval Engineers. It contains a very complete synopsis of engine packings since the advent of steam, and goes into the metallic packing practice and theory in a manner which will be read with interest by any engineer. A limited number of copies of the paper will be sent to readers of the PRACTICAL ENGINEER, free of charge, upon application to Charles Longstreth, 13th and Noble Sts., Philadelphia, Pa.

Fluted piston rods are the bane of all engineers and almost all packing men; but the Hileman-James Company, 404 Frick Building, Pittsburg, Pa., are sending out a leaflet showing their method of packing such rods in a manner they assert, will ensure redemption from further trouble of that kind. A postal with mention of this paper will receive prompt return to the enquirer of the booklet mentioned.

"A leaky oil can is indicative of a careless engineer" is a quotation often used, yet it is not always easy to get the unleaky kind. Some valuable pointers on this subject may be had by writing the Gem Manufacturing Co., Spruce St. near 33rd., Pittsburg, Pa., for their descriptive booklet upon the Gem Steel Brazed Oilers and Torches. Please mention the PRACTICAL ENGINEER.

In mechanics the element of simplicity, efficiency, and rapid operation combined, constitute an increased condition of value. A device without efficiency lacks in practical utility, and without simplicity and quickness in operation, fails in its economic value. These logical facts are as true to-day as ever. All of these elements are combined in the Bettermann Boiler Flue Plug and it will repay engineers to write to Reinhold Bettermann, Johnstown, Pa., fo rhis descriptive catalogue of flue plugs.

In the construction of the valve lies the chief merit of a trap. It must be of durable metal to withstand the severe wear occasioned by high pressure steam. It must be designed so as to insure its working without interruption either from sticking or being broken, and it should be arranged to permit of its being easily and quickly inspected or repaired, when occasion demands. Application to The Handy Trap, 639 Arch Street, Philadelphia, Pa., receives prompt attention by the return to the writer of an instructive bookle, entitled "The Evolution of the Handy Trap."

The Harrison Safety Boiler Works, Philadelphia, Pa., announce a change in their sales department, whereby Mr. J. M. Dashiell, who has represented them in New England under the title of the Dashiell Engineering Company, 1103 Paddock Building, Boston, Mass., is now placed in charge of their Baltimore section.

The New England office will be continued at the above address, under the title of the Harrison Safety Boiler Works, with Mr. John Hickey as representative.

Every engineer should try and secure a copy of the latest issue of the Larkin Metallic Packing Catalogue, as it contains matter he cannot afford to be without. Not only does it describe the value of the Larkin packing, but it also contains instructive illustrations upon packing ammonia compressors and pumps. Address, the Pennsylvania Electrical and Railway Supply Company, Pittsburg, Pa.

Made in the form of, and to take the place of, an ordinary water column, Berry's Boiler Feed Control is a unique and very valuable boiler accesory. It controls the feed water, holding it always at the same point in the boiler. Should this feature be dispensed with temporarily for repairs or other reasons or should it fail to work, there is an alarm whistle, which will immediately notify the engineer if the water should get too high or too low. The manufacturers have published quite an interesting catalogue describing the device in detail, copies of which they will send to engineers or steam-users, mentioning this journal. Write to Berry Engineering Company, Chester, Pa.

Gaskets, especially for boiler manholes, have always been a vexatious problem for engineers; some blow out, others stick tight to the iron and are difficult to remove when boiler is opened, but few can be used a second time, especially where high pressures are carried. The Standard Gasket Co., 7 So. 36th St., Philadelphia, manufacture a special metal boiler Gasket, which they say will stand 250 lbs. pressure and can be used from twenty to thirty times. They also make corrugated copper gaskets for every service.

The Garlock Packing Co. have established an office and salesroom at Hamburg, Germany, for the purpose of supplying their European trade.

Here, in America, we admire and encourage a hustler; over in Europe, they envy and obstruct him. It is America's hustlers that have made America what it is and caused all the rest of the world to admire us. A hustler in any line of business stimulates the whole field just as a tonic braces an individual, and just as the many hustlers stimulate America. Not all the hustlers have been in the field of steam engineering, but we have had a fair share of them, and not the least of the more recently developed is the firm of Jas. McCrea & Co., of Chicago. The firm is composed of Mr. McCrea and Mr. Skinner, and if you haven't met them, you have missed one bracer. Each is a typical American hustler and hailing from that intensely American city, with a pleasant greeting for all and big lungs full of that air, the wonderful expansive qualities of which has made Chicago famous. They have each become favorites with the engineers who know them. Their success with the Climax Steam Joint Clamp has made their firm name familiar everywhere.

The Bruun-Lowener apparatus for purifying and softening water for boiler feed and other industrial purposes, seems to be meeting with favor very rapidly. The American Water Softener Co., Harrison Bldg., Philadelphia, have installed a large number of new plants throughout the east, among the more recent of which were for the Phila. Pneumatic Tool Co., Lalance, and Grosjean Mfg. Co., Woodhaven N. Y., and S. Liebmann's Sons Brewing Co., Brooklyn, N. Y. They are also installing plants for Heine Safety Boiler Co., Phœnixville, N. Ward & Co., Boston, Newark Sanitary Reduction Co., Newark, N. J., Jenkins Rubber Co., Elizabeth, N. J., and the Old Colored Home of Phila. Some of these machines have now been in operation for more than a year and have been giving excellent satisfaction.

The General Engineering Co., 763 Swanson St., Philadelphia, have increased their business of engine repairs and general machine work to such an extent that they frequently have to run night and day, so in order that no time should be lost in case of break down jobs or unlooked-for Sunday work, they have installed a large new gas engine, which can be started up at a moment's notice.

Every engineer should be thoroughly posted on the various brands of packings, lubricants, oil cans, and other supplies used in the steam plant. He should also know prices so that he can answer any questions that may be asked him by superintendent or employers. John M. Watt's Sons, 125 So. Second St., Philadelphia, publish a nice little catalogue and wil be glad to quote prices on a full line of high grade packings and engineers' supplies.

With all the great amount of belting that is used and the many manufacturers of belting it is very rare that we see a catalogue, booklet, or even a circular treating upon belting that is of any practical value to an engineer, About the best thing of this kind that we have seen, recently, is a booklet issued by D. P. Brown & Co., 264 N. Fourth St., Philadelphia. Copies will be sent to any one interested.

The Otis feed water heater serves a double purpose, which has recently attracted considerable attention. The manufacturers claim that it extracts practically all the oil from the exhaust and they have frequently proved their claim to the entire satisfaction of intending purchasers. This is a feature well worth considering and we would suggest that those who are interested, or who contemplate purchasing a heater, write for a catalogue and further details to the Stewart Heater Co., 11 Norfolk Ave., Buffalo, N. Y.

Mr. V. O. Lawrence, the genial and well known general manager of the George W. Lord Co., of Philadelphia, manufacturers of the famous Lord's Boiler Compounds, sailed for Europe on June 27th, to be absent until September. It is purely a business trip made necessary by the rapidly increasing foreign demand for Lord's Compounds. Mr. Lawrence will touch all the large cities in England and on the continent, Mrs. Lawrence will accompany him as far as

Berlin. Since Mr. Lawrence's last trip to Europe, the foreign business of the Company has grown wonderfully.

The Lagonda Mfg. Co., Springfield, Ohio, say the past month was the best they ever had since they commenced the manufacture of their Tube Cleaners. The demand for these machines seems to be growing fast. They have been crowded out of the factory which they have occupied for the past year and have built a much larger factory of their own, which is equipped throughout with special tools and machinery adapted for the particular work which they have to do, but even in their new quarters, they are compelled to run over time in order to keep up with the demand made upon them for machines.

This is certainly a very encouraging report, and the company are to be congratulated. We think it is due largely, to the fact that Mr. Weinland is a practical engineer and understands what is needed in the way of a cleaner for removing scale, his knowledge and experience has enabled him to produce a Cleaner which is not only a rapid worker but is strong and durable. Boiler cleaning is one of the most difficult jobs the engineer has to perform. It is a source of continual worry to him as well as a matter of anxiety to the Superintendent, as tubes in bad condition not only cut down the power supply, but add largely to the fuel bills. All this can be remedied by the use of "Weinland" Cleaners. In addition to Tube Cleaners, this company is now making Feed Water and Damper Regulators and will be pleased to correspond with any one interested in anything along these lines. For catalogues, prices or other information, address Lagonda Mfg. Co., Springfield, Ohio.

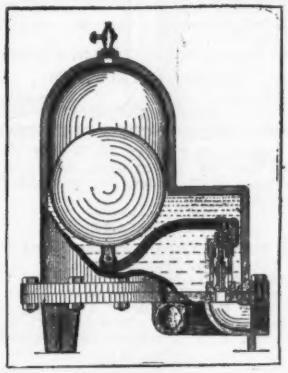
Mr. J. L. Robertson, Sr., of Jas. L. Robertson & Sons, 205 Fulton St., New York, has just returned from a fishing trip in the most northeasterly corner of Maine and is chock full of fishing stories. We won't repeat them all, but he says he caught so many salmon that if put together they would swamp the canoe. He is a good fisherman? Whether the fishing trip enthused him, we don't know, but he says that their orders for Eureka Packing and Robertson-Thompson Indicators show a large increase over previous months in any previous year. They are like salmon—far ahead of all others, and the best people want them.

The Sterling Pipe & Blower Co. of Hartford City, Conn., is now furnishing the exhaust heads for the new Bellevue Stratford Hotel, Philadelphia. These exhaust heads are made of 48 ounce copper, and while our representative was in Hartford City, recently, he wasshown through the establishment, and saw these and many other exhaust heads in course of construction, including a 36 for the Springfield (Mass.) Power Company. These exhaust heads are a first class article, and anyone in need of such goods will do well to correspond with the Sterling people, and are assured of prompt attention and fair prices.

The Wisconsin Graphite Co., Box 988, Pittsburg, Pa., have a neat folder for distribution, showing the virtues of graphite as a pipe joint paste, and stating reasons why no joint should be made up without the use of graphite. A postal will secure it.

IF ENGINEERS will send $1.00 to the address below they will receive two blue prints, with tables and instructions, showing how to set valves and eccentrics on Corliss engines, simple and compound, with one and two eccentrics. JOHN T. LINDSTROM, 214 and 216 S. 3d St., Allentown, Pa.

A GOOD THING



The "FORD" Compound Steam Trap

We want you to take hold of it. Made in 5 sizes. Has large outlet and the largest capacity of any Steam Trap on the market.

Write for full particulars and prices.

Thomas P. Ford Co.

SCHADE & MARSHALL

PHILA. AGENTS

319 HARRISON BUILDING PHILADELPHIA, PA.

HOW FAR DOES YOUR OIL GO?

If you use your lubricating oil only once, you are losing a lot of money.

The oil you are throwing away may be used again and again, after it has been cleaned and filtered through a

CROSS OIL FILTER

It cuts down the oil bills from 50 to 75 per cent., because it makes your oil go two or three times as far as before.

Let us put in a Filter for you to try 30 days. When it proves to your satisfaction that it will save half the money you pay for oil, send us the money. If not, return the Filter at our expense.

Will you write for it today?

One man says: "It saves enough lubricating oil in a year to pay for many filters."

THE BURT MFG. CO., AKRON, O., U.S.A.

Largest Manufacturers of Oil Filters in the World.

Cross Oil Filters carried in stock by the

FAIRBANKS CO.

Sole Agents for Philadelphia

Dixon's Flake Graphite adds to the lubricating power of any grease and any oil greatly out of proportion to the amount used. Actual test shows that one-seventh of the lubricating graphite added to the oil increases the lubricating power one-half. Ask for booklet 96-c.

Joseph Dixon Crucible Company, Jersey City, N. J.

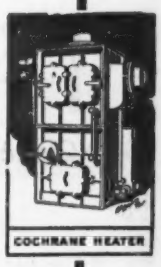
Making 4 Tons of Coal Do the Work of 5 Tons

IN MANY CASES the installation of a Cochrane Feed Water Heater, without any change in your boilers, engines or other equipment, will enable you to do with four tons of coal what formerly required five tons—simply because you save the heat value of your exhaust steam and utilize it to better advantage. Even in a plant run all condensing, a Cochrane Heater will make nine tons do the work of nearly ten.

From 5 to 20 per cent is the saving in fuel you can count on if you install a Cochrane Heater, the exact percentage depending upon the conditions, and in some cases where "Cochranes" have been used the saving has exceeded 20 per cent.

But that isn't all. A Cochrane Heater will materially purify your feed water, it will enable you to make steam faster and in greater quantities, and it will lessen the strain on your boilers and increase their life.

The design, the construction and the service these Cochrane Heaters perform, are solid arguments why you ought to have one. Why not start the ball by asking for our Catalogue 16-H and the price of the size of Heater suitable for your plant?



COCHRANE HEATER

HARRISON SAFETY BOILER WORKS, 3144 N. 17th Street, Philadelphia, Pa.

Manufacturers of Cochrane Steam and Oil Separators and of the Sorge-Cochrane System

American Order of Steam Engineers.

ORGANIZED APRIL 27, 1886.

An Order of Engineesr for Engineers and Engineers only.

DECLARATIONS OF PRINCIPLES

Believing that ability will bring its full value in this country, this Order shall at no time take part in strikes, nor in any way interfere between employer and employees. Recognizing their identity of interests, it shall take no part in any project or enterprise that shall interfere with perfect harmony between them ; neither shall it be used for political or religious purposes.

These principles shall not be amended or repealed except by unanimous vote of the Order.

Any member who shall be guilty of violating the principles of the Order shall be expelled.

OBJECTS.

First.—To promote a more thorough knowledge in its members of theoretical and practical steam engineering.

Second.—To assist members to obtain employment.

Third.—To help the sick, injured and distressed and bury the dead.

Fourth.—To establish a Widows' and Orphans' Fund.

Fifth.—To help members who shall become incapacitated from following the profession to obtain employment suited to their affliction.

Sixth.—To do our utmost to extend the license law throughout the United States.

Seventh.—To establish schools in which our members may study the highest branches of steam engineering.

MEMBERSHIP.

An applicant for membership must be an engineer between twenty-one and fifty years of age, and must be a white male citizen of the United States, of good moral character and be a believer in the Supreme Being, and be free from all physical infirmities.

He must have had three years' service in an engineering department, or if a machinist, or graduate of a technical institute, then one year's service, in such department, and in localities where engineers are required by law to be licensed, they must have such license, and must satisfy the investigating and examining committees of the council to which he applies as to his character and ability.

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Engineers who have passed the age limit may be admitted to life membership. They must possess the same qualifications and pass the same examination as are reqnired in the next proceeding clause: They shall be entitled to all rights and privileges of the Order except they cannot vote on financial questions or for the election of officers or be entitled to any sick or death benefits.

DIRECTORY.

The Publication Committee of "The Practical Engineer" desires that the Corresponding Engineers of all Councils of the American Order of Steam Engineers send the name of their Chief Engineer and their own name and address, together with the time and place of meeting, to the Secretary of the Publication Committee immediately after each election of officers. Address J. C. McDowell, Secretary, in care of "The Practical Engineer," 1215 Filbert Street, Philadelphia.

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Delaware Council, No. 1, meets every Wednesday at S. E. Cor. Fourth and King Sts. Chief Engineer, Harry W. Sherman. Corresponding Engineer, A. E. Deakyne, 406 Lombard St.

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Deputy Supreme Chief Engineer, A. J. Deidrich, 226 North Caroline St., Baltimore, Md.

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Maryland Council, No. 1, meets 2nd and 4th Fridays in Royal Arcanium Hall. Chief Engineer, Geo. Goodwin. Corresponding Engineer, Wm. S. Smith, 533 Sharp St., Baltimore.

Energy Council, No. 2, meets every Wednesday of each month in Bauer Hall, Chesapeake and Elliott Sts. Chief Engineer, T. E. Eaton. Corresponding Engineer, Thos. O. Daneker, 834 East Ave.

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Deputy Supreme Chief for Eastern District, W. E. Packard, Whitmann.

BOSTON.

Boston Council, No. 4, meets 2nd and 4th Thursdays of each month, in Templar Hall, 724 Washington St. Chief Engineer, A. R. Abbott. Corresponding Engineer, Phillip Sanford.

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Old Colony Council, No. 14, meets 2nd and 4th Saturdays in the American Foresters' Hall. Chief Engineer, Herbert W. Jones. Corresponding Engineer, James K. Sedgwick, Box 333, Rockland, Mass.

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Stevens Council, No. 1, meets 3rd Saturday, at Water, near Lafayette St. Chief Engineer, Lawrence Oliver. Corresponding Engineer, James H. White.

CAMDEN.

Camden Council, No. 3, meets every Thursday evening at N. E. Cor. Second and Federal Sts. Chief Engineer, C. H. Harigle. Corresponding Engineer, C. H. Pfeiffer, 571 Berkley St.

ATLANTIC CITY.

Atlantic City, No. 4, meets every Tuesday evening at Merchants, Cor. Atlantic and New York Aves. Chief Engineer, Wm. Fowden. Corresponding Engineer, W. S. Price, Haddon Hall.

BRIDGETON.

Bridgeton Council, No. 5, meets every Friday. Chief Engineer, David Sellers. Corresponding Engineer, Francis O. Garrison, Bridgeton, N. J.

MILLVILLE.

Millville Council, No. 6, meets every Saturday, 7.30 P. M., in G. A. R. Hall, East Main St. Chief Engineer, Geo. Esabel. Corresponding Engineer, Lewis Doughty, 604 Mulberry St.

NEW YORK.

SYRACUSE.

John E. Sweet Council, No. 6, meets Monday, Room 23, Nottingham Block, East Washington St. Chief Engineer, John Cunningham. Corresponding Engineer, S. A. Steel, 311 Orange St.

PENNSYLVANIA.

Grand Chief Engineer, Hiram Trout, 1042 Locust St., Reading, Pa. Deputy Grand Chief for Philadelphia and Delaware Counties, John P. Rickards, 2707 N. Broad St., Philadelphia. Grand Corresponding Engineer, Frederick Markoe, 931 Orianna St., Philadelphia.

Deputy Grand Chief for Western Pennsylvania, A. D. Hamilton, 2025 Forbes St., Pittsburg, Pa.

PHILADELPHIA.

Germantown Council, No. 22, meets every Wednesday evening at Main and Seymour Sts., Germantown. Chief Engineer, L. F. Souders. Corresponding Engineer, Frank MacIndoe, 3519 Ainsley St., Falls of Schuylkill, Philadelphia.

Welcome Council, No. 2, meets every Friday, N. W. Cor. Twelfth St. and Columbia Ave. Chief Engineer, Paul Pieling. Corresponding Engineer, L. D. Woodington, 2428 N. Bancroft St.

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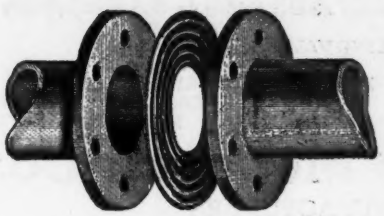

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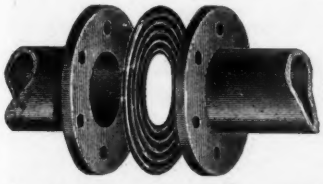

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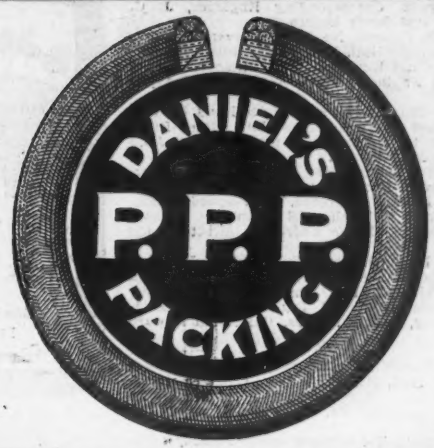

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Manayunk Council, No. 9, meets 2nd and 4th Friday evenings in Temperance Hall. Chief Engineer, John Hill. Corresponding Engineer, John Clevenger, 211 Lofty St.

Helping Hand Council, No. 12, meets every Thursday evening at Kensington Ave. and C St. Chief Engineer, Edward Laurence. Corresponding Engineer, Frank McHugh, 2503 Tulip St. All correspondence should be addressed direct to the Council.

Municipal P. F. D. Council, No. 20, of Philadelphia, meets the second Thursday of each month at Odd Fellows' Hall, Third and Brown Sts. Chief Engineer, Daniel Bunting. Corresponding Engineer, Walter Meyers, 1211 North Howard St.

PITTSBURG.

Iron City Council, No. 21, meets every Saturday at Arnfeld Hall, 1119 Penn Ave. Chief Engineer, J. J. Stewart. Corresponding Engineer, Alex. Fraser, Carnegie, Pa.

GIRARDVILLE.

Girard Council, No. 8, meets every Tuesday evening at O'Neill's Hall, Second and Ogden Sts. Chief Engineer, Jacob Weber. Corresponding Engineer, M. J. Carey, Lock Box 214.

ALLENTOWN.

Lehigh Council, No. 15, meets every Wednesday evening at 639 Hamilton St. Chief Engineer, John evening at 639 Hamilton St. Chief Engineer, Henry C. Snyder. Corresponding Engineer, A. P. Driesbach, 728 Chew St.

POTTSTOWN.

Pottstown Council, No. 14, meets 1st and 3rd Saturday evenings at P. O. S. of A. Hall, Cor. High and Hanover Sts. Chief Engineer, Wm. Rickert. Corresponding Engineer, H. L. Shirey, 363 Cherry St.

READING.

Progress Council, No. 13, meets every Saturday evening at Diebert Hall, Ninth and Penn Sts., Room 4. Chief Engineer, A. B. Hess. Corresponding Engineer, Frank S. Miller, 3 West Franklin St.

CHESTER.

Delaware County Council, No. 6, meets every Wednesday evening in the Carpenter Hall, Sixth and Wall Sts. Chief Engineer, John Canavan. Corresponding Engineer, E. E. McCoy, 2222 West Third St.

YORK.

York Council, No. 16, meets every Wednesday Evening in the Jordan Block. Chief Engineer, A. L. Bair. Corresponding Engineer, Walter H. Long, 23 East Philadelphia St.

HARRISBURG.

Capitol City Council, No. 17, meets every Tuesday evening in Red Men's Hall, Market St., above Second. Chief Engineer, B. H. Shafer. Corresponding Engineer, S. Filson, 1126 Market St.

COLUMBIA.

Columbia Council, No. 18, meets every 1st and 3rd Saturdays, in Odd Fellows' Hall. Chief Engineer, Amos Simmons. Corresponding Engineer, W. J. Courtney, 804 Walnut St.

SUNBURY.

Sunbury Council, No. 19, meets every Monday evening in Zartman's Hall. Chief Engineer, H. E. Culp. Corresponding Engineer, Ed. Schrieber.

WISCONSIN.

Deputy Supreme Chief Engineer, Joseph P. Harris, No. 1611 Clybourn St., Milwaukee.

MILWAUKEE.

Washington Council, No. 1, meets every Saturday at 207 Grand Ave. Chief Engineer, J. B. Chambers. Corresponding Engineer, James A. Rigby, 136 Reed St.

Clifford P. Williams Council, No. 2, meets every Monday evening at Lodge Hall, E. Water St. Chief Engineer, Elmer Towers. Corresponding Engineer, Joseph T. Harris, 1611 Clybourn St.

TENNESSEE.

Deputy Supreme Chief Engineer, John B. Mullen, 326 Central Ave., Nashville.

NASHVILLE.

Enterprise Council, No. 1, meets every Friday evening in the Twin Building on Cedar St. Chief Engineer, J. J. Johnson. Corresponding Engineer, Jno. B. Mullen, 209 Jackson Building.

OREGON.

Deputy Supreme Chief Engineer, Nat. Freese, Grant's Pass, Oregon.

GRANT'S PASS.

Oregon Council, No. 1, meets every 1st and 3rd Saturday in A. O. U. W. Hall, Main St. Chief Engineer, William H. Kenny. Corresponding Engineer, Nat Freese.

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Deputy Supreme Chief Engineer, S. A. Bisbey, care of Cotton Compress and Warehouse Co., Galveston.

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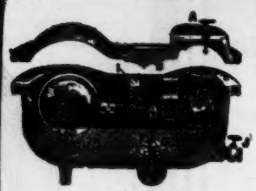
Galveston Council, No. 1, meets every 2nd and 4th Tuesday evenings at Engineers' Hall, S. W. Cor. Twenty-second and Strand Sts. Chief Engineer, Max Levy. Corresponding Engineer, A. L. Bradford, Union Depot.



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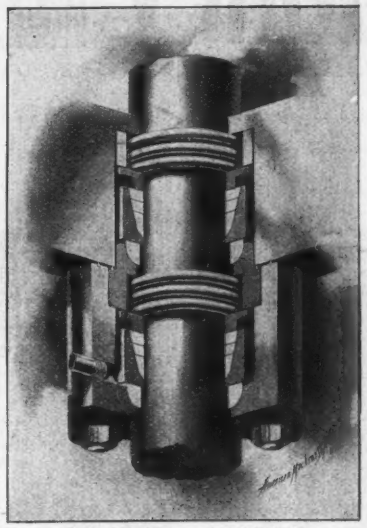

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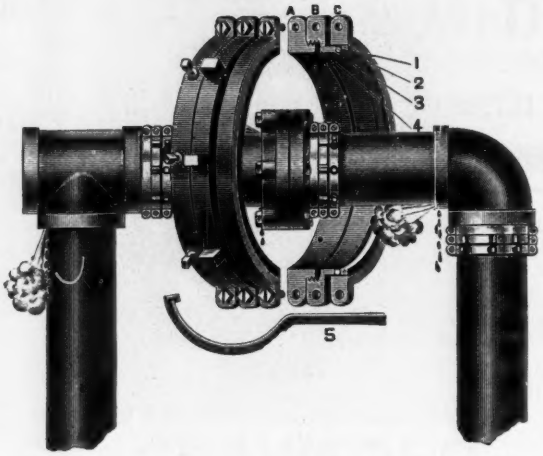

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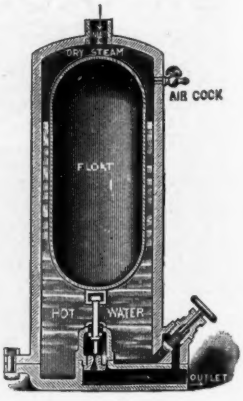

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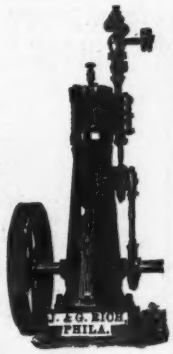

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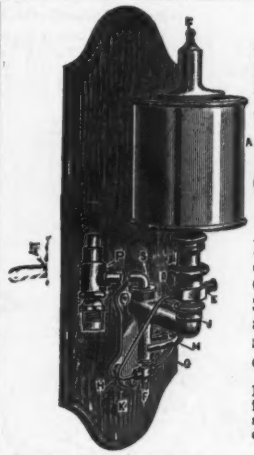

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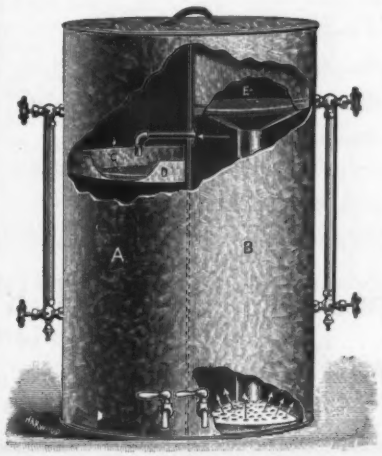

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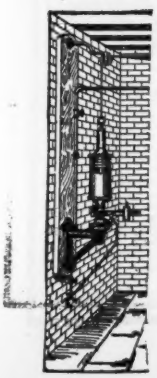

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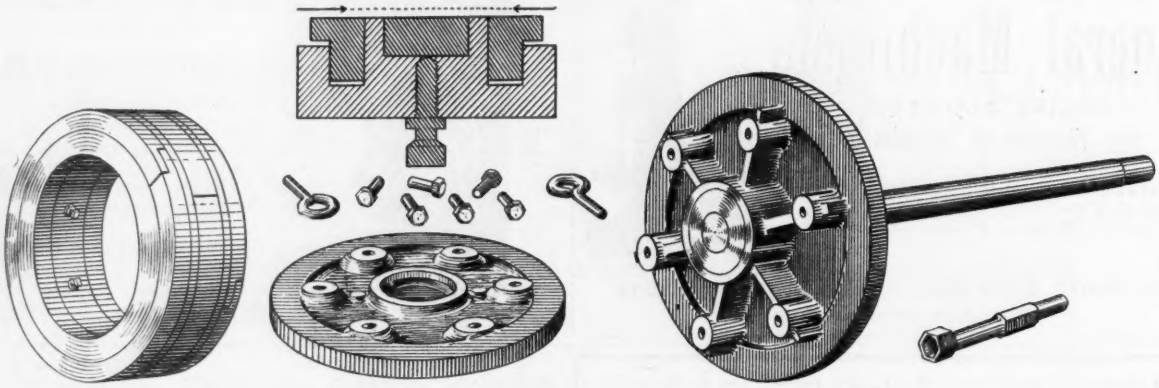

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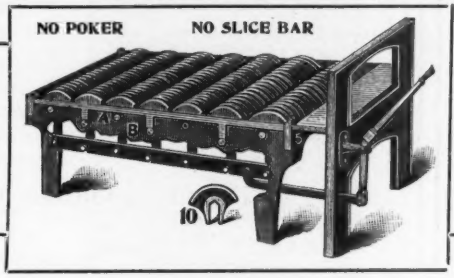

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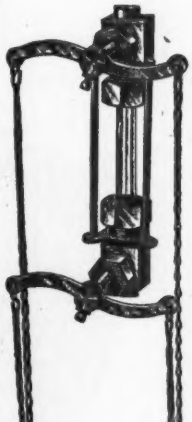

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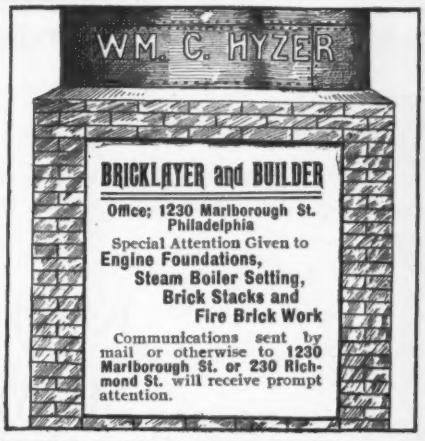
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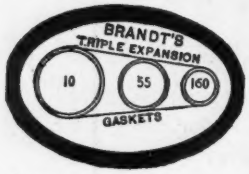

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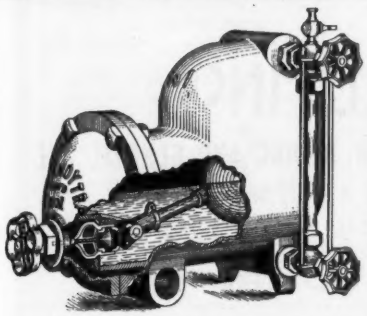

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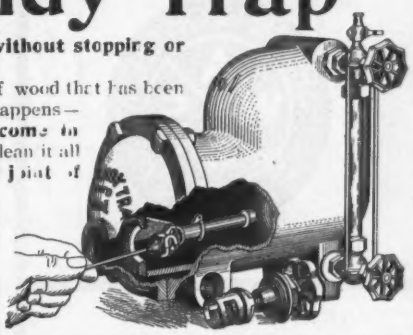

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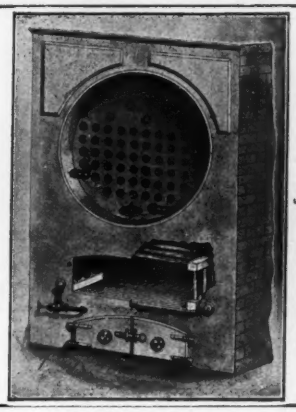

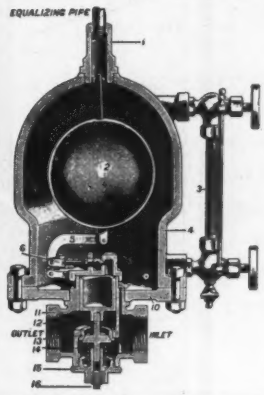

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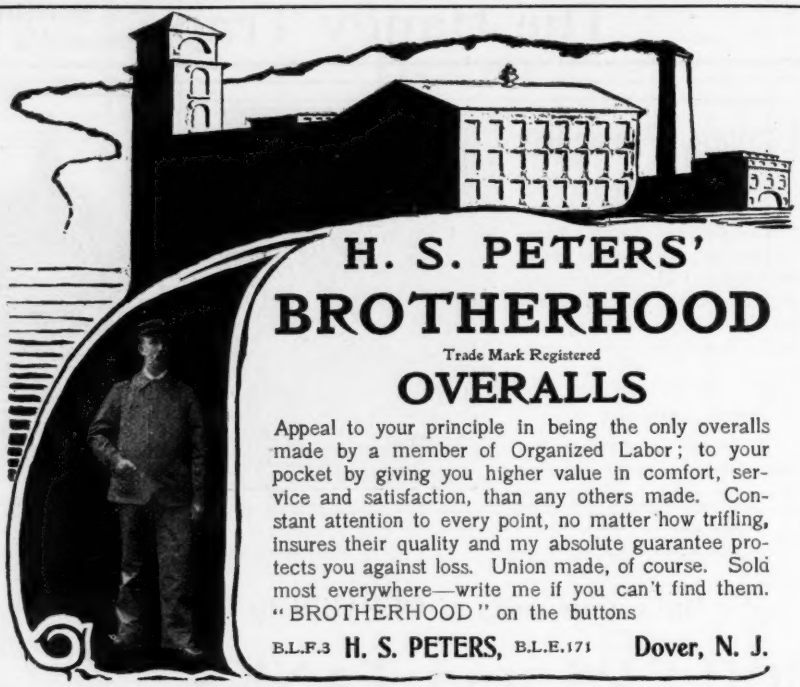

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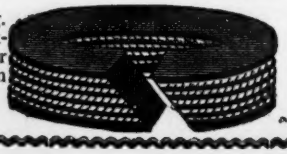

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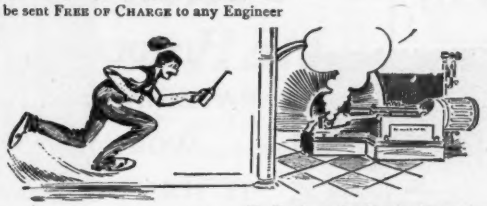

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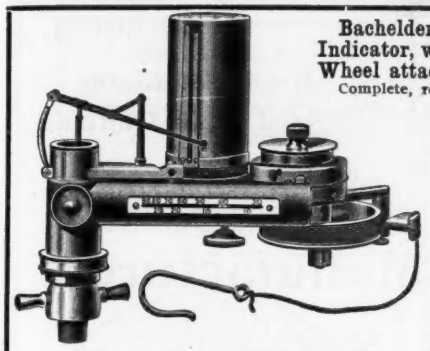

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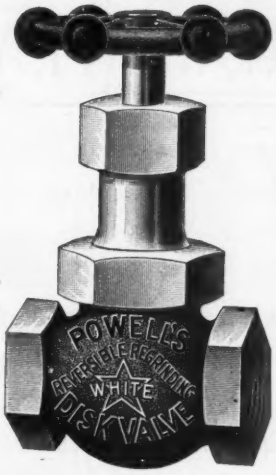

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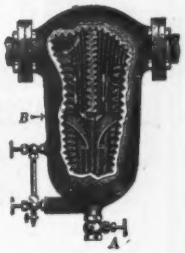

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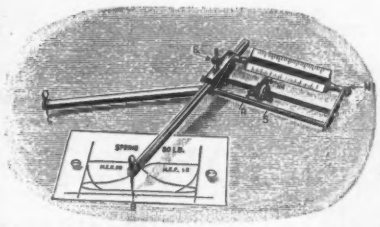

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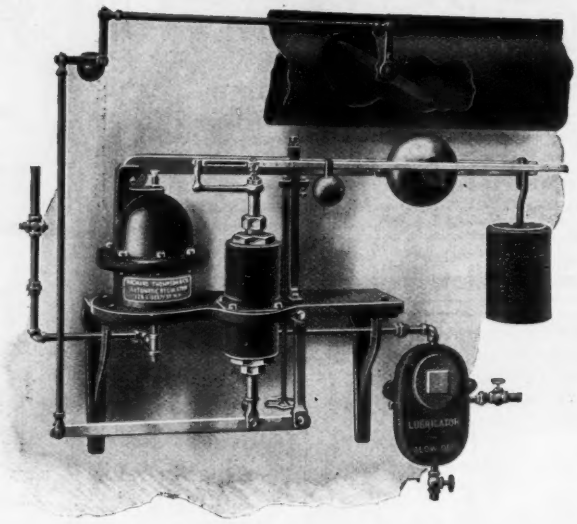

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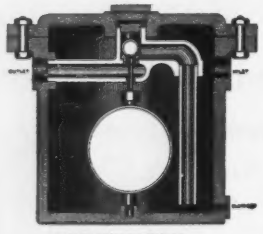

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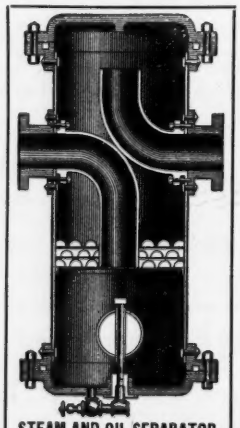

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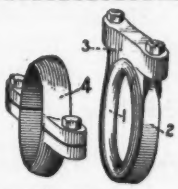

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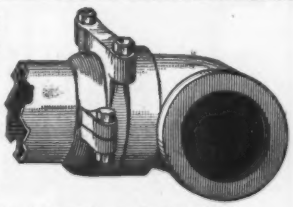

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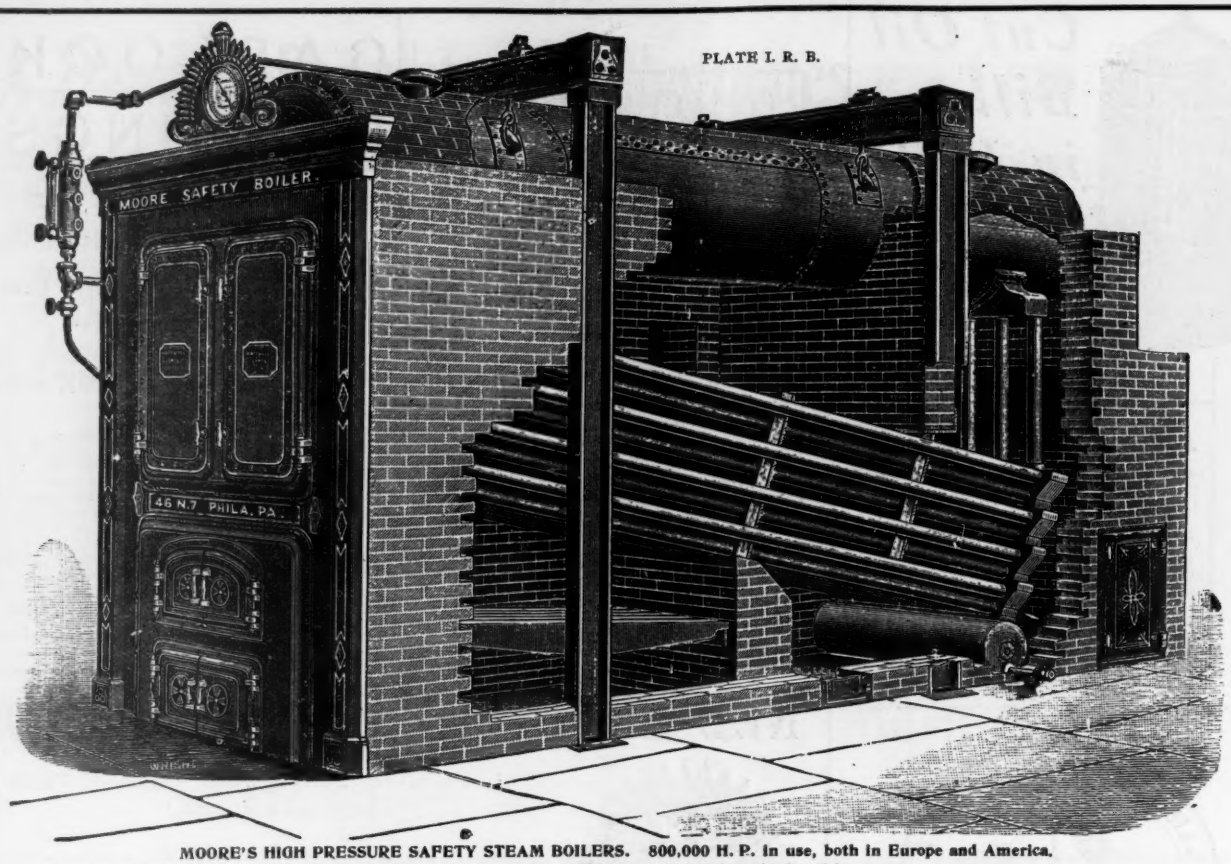

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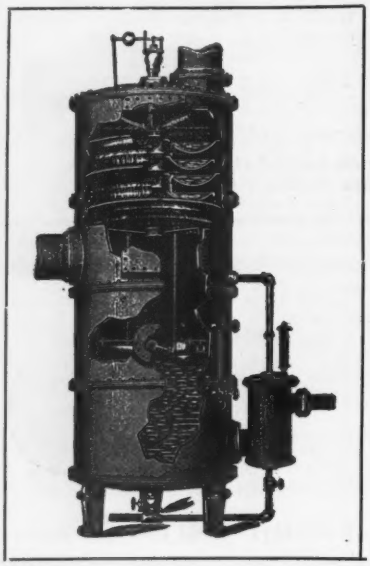

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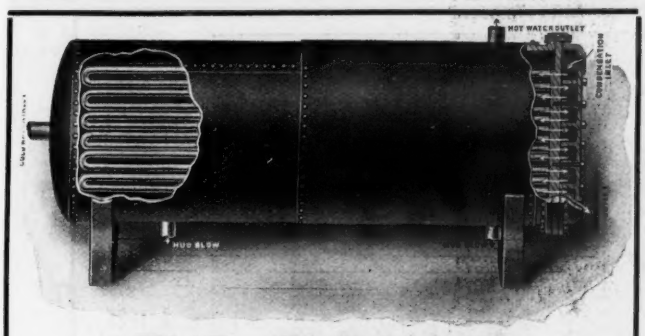

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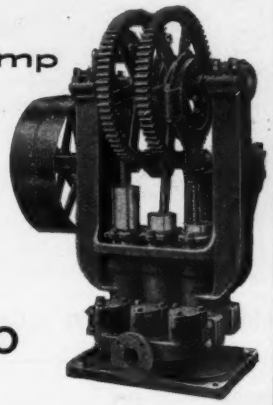

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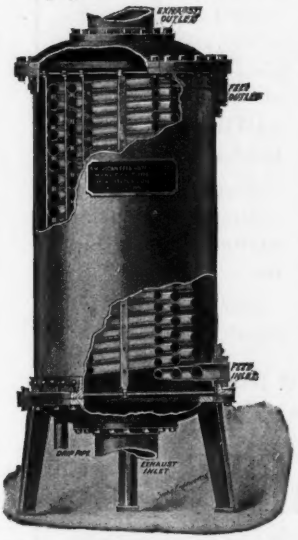

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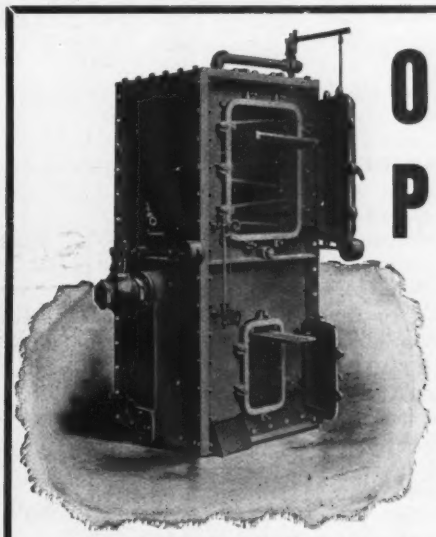

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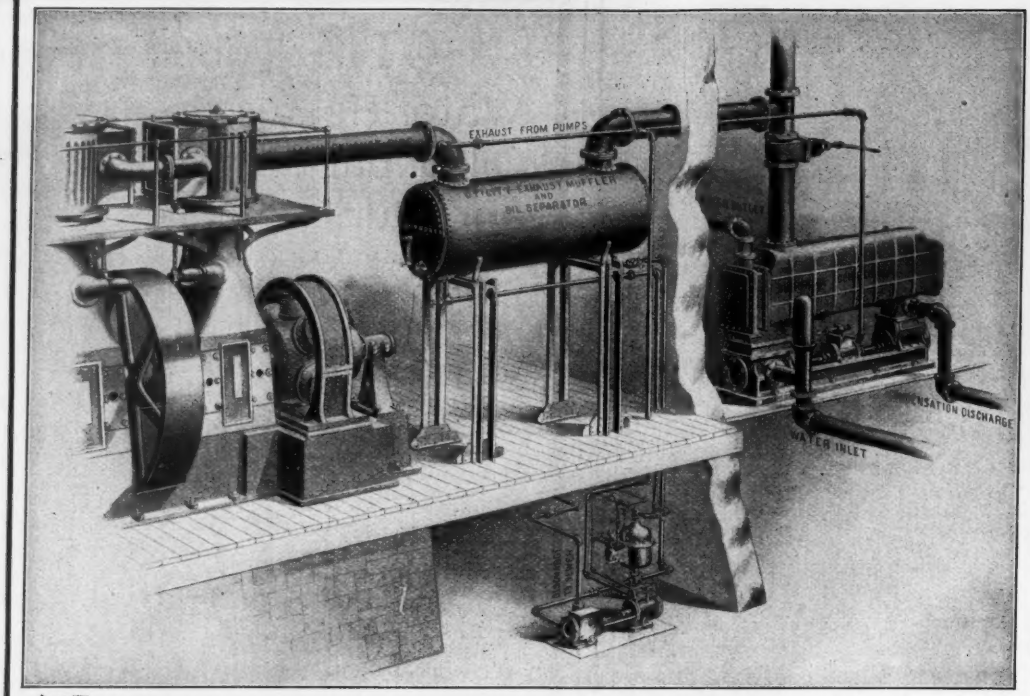

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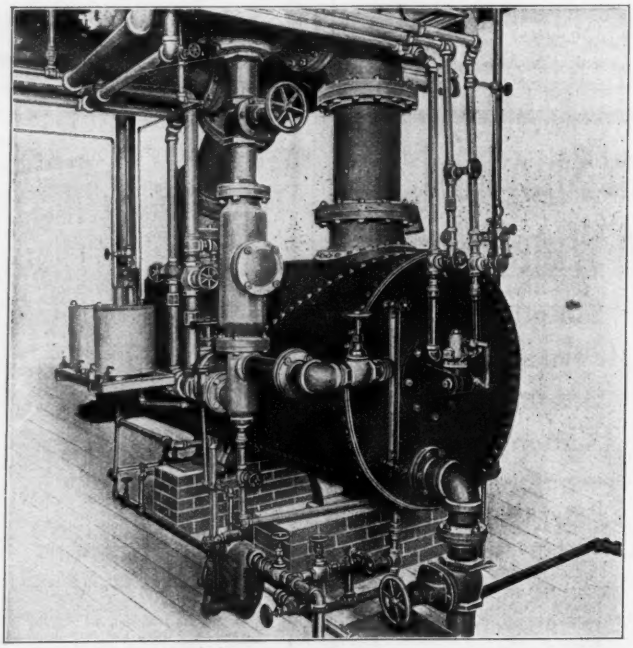

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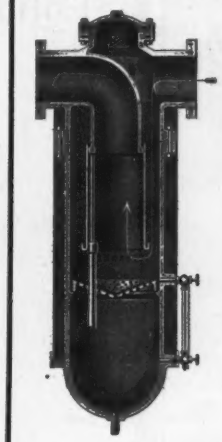

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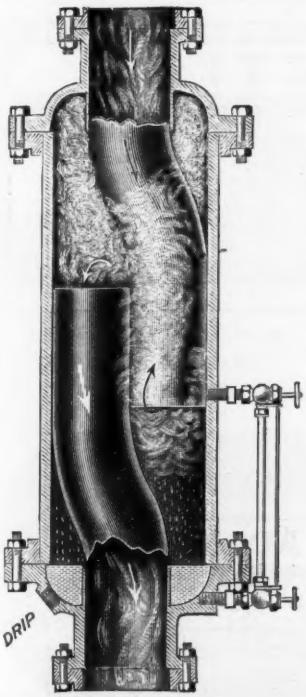

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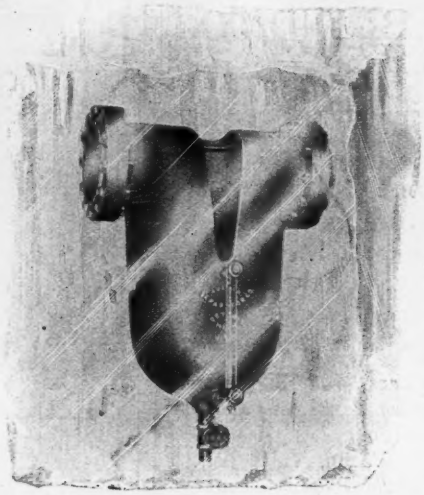

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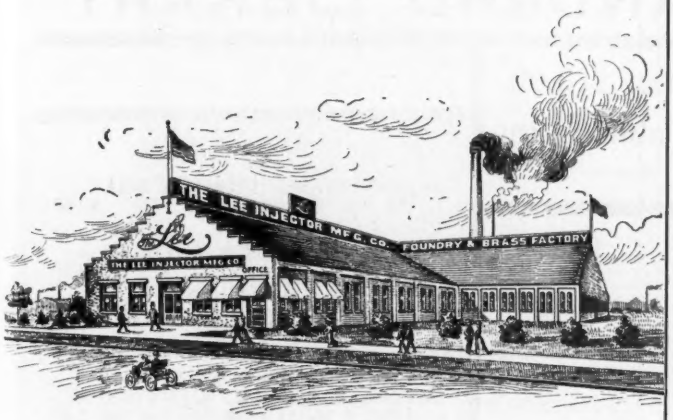

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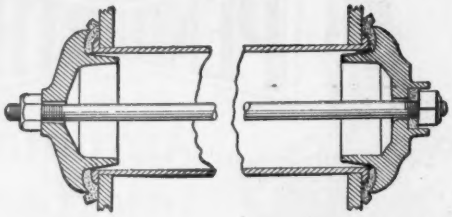

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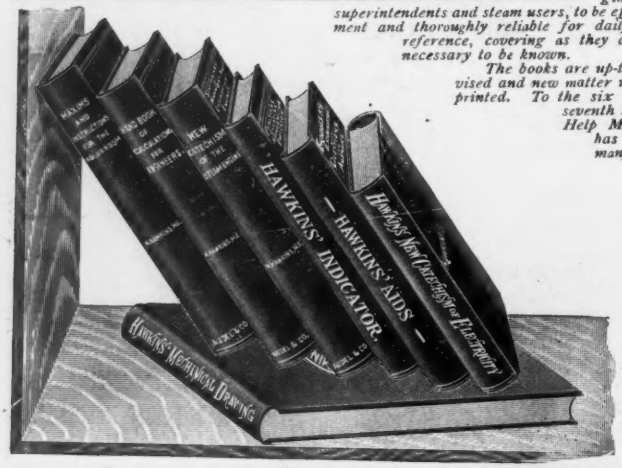

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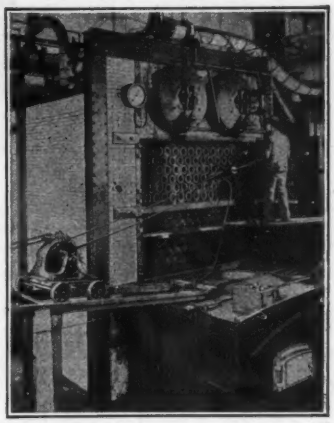

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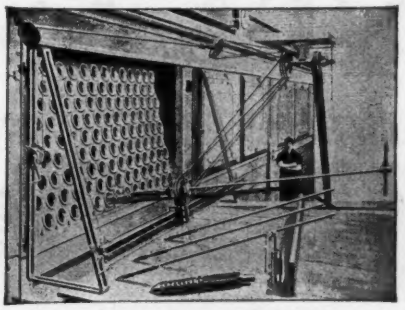

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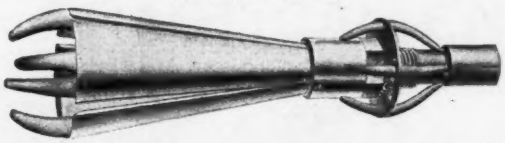

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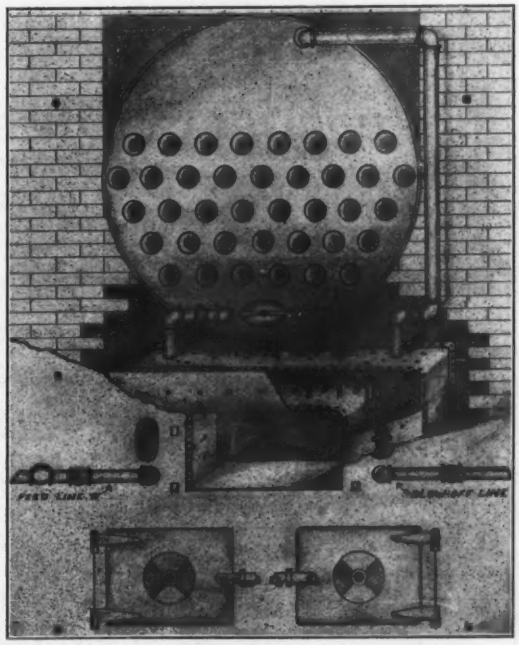

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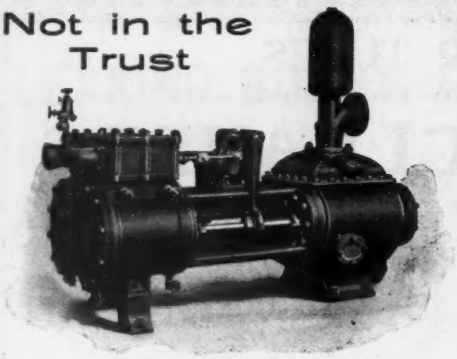

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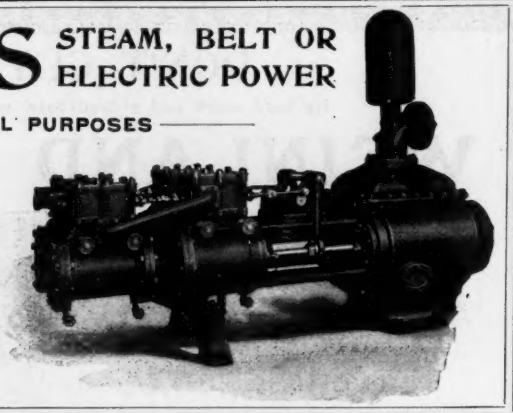

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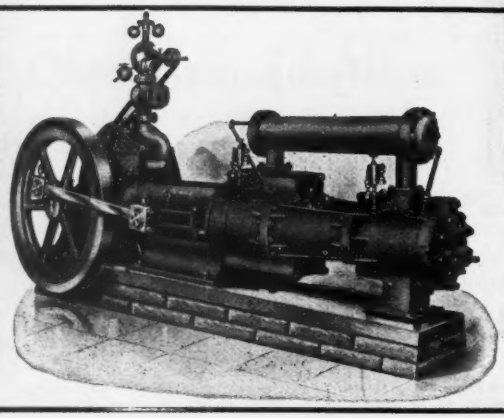

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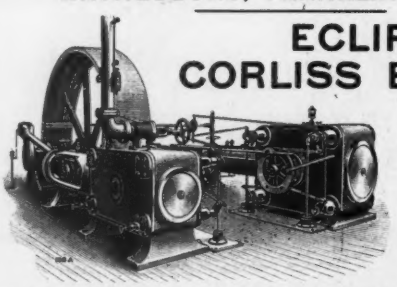

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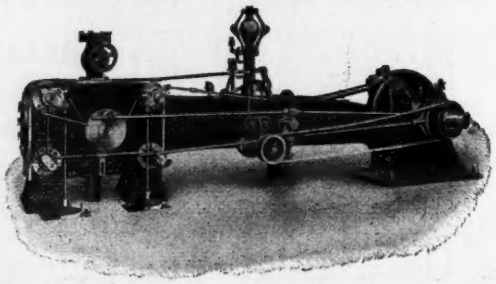
ATLAS



ENGINES AND BOILERS

KENOSHA, WIS., May 26, 1903.

ATLAS ENGINE WORKS, Indianapolis, Ind.

DEAR SIRS:—I am not running an Atlas Engine now but have run them and I will say they are all right, economical and quick. Respectfully,

CHAS. L. CRAWFORD,
577 Chicago Street.

CATALOGUES ON REQUEST

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JOHN J. SPROUL, Vice-President and Manager W. J. GREENHOUGH, Secretary and Treasurer

HAVE YOUR

ELEVATORS

REPAIRED

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Keystone Elevator Inspection and Repair Co.

Removed to 923 Locust Street, Philadelphia

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We Carry Repair Parts in Stock, and Will Work Holidays and Nights When Necessary

ESTIMATES ON NEW WORK

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MORSE, WILLIAMS & CO.

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We have the largest and most complete Elevator Plant in Philadelphia, also a down-town storeroom, and skilled mechanics, especially for Repair Work.

Excelsior Elevator Company

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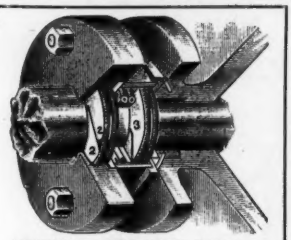
AIR CUSHIONS, Automatic Car-Locking Devices, Mechanical and Electrical Indicators, Automatic Door Mechanism, Steam and Power Pumps, Electrical Annunciators, Safety Gates, Air Pumps, Air Tanks, Pressure Regulators, Etc.

Repairs and Alterations of Elevator Plants

A SPECIALTY

Bell Telephone 3-47-60 Keystone, Race, 1-47

A PRACTICAL ENGINEER'S INVENTION



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Outside Type

France's Metallic
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Built on scientific principles Guaranteed to meet all requirements

ABSOLUTELY PREVENTS THE ESCAPE
EITHER OF STEAM OR AMMONIA

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LORD'S WATER PURIFYING CHEMICALS

Remedies to Suit Every Case

We have no fixed boiler compound. We analyze the scale from your boiler and thus find out just what the particular water you use requires to make it suitable for use in a boiler. With this information in our hands, we make a special compound which will keep your boiler free from scale. This will decrease the cost of fuel and increase the efficiency of your boiler.

The Analysis is Free

We also give you a certificate of analysis. There are no "ifs" about it, it is not even conditional upon your purchasing some of our chemicals.

Fill out the coupon, giving data requested thereon, and send us a sample of the scale from your boiler whether you intend purchasing or not. If you send the scale under separate cover be sure to put your name and address upon it.

Don't Delay—Do It To-day

..... 1903

The Geo. W. Lord Co.,
2238-50 N. 9th Street,
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Gentlemen:—I am sending you a sample of scale from our boiler. In accordance with your offer in the June PRACTICAL ENGINEER you are to analyze it, and send me certificate of analysis free of charge.

Number of boilers in use.....

Capacity of each boiler.....

Frequency of cleaning boilers.....

Frequency of opening the blow-off during working hours.....

River or other source of water supply.....

Boilers are used about.....hours out of the 24.

Name.....

Street and No. .....

City and State.....

Firm's Name .....

One Grease The Year Around

No need of a summer and winter grease, for climatic changes do not effect it. That's because Keystone Orease is made by a dry heat process and requires 300° Fahrenheit to melt it.

Keystone Grease

has many other strong points that we want you to learn for yourself. This you can do by sending for a large sample and brass grease cup, which will be sent free of charge, express pre-paid. It will pay you to send for it. Don't delay. Do it to-day.

Keystone Lubricating Co.

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MADE IN ENGLAND

WATER PROOF, STEAM PROOF, HEAT PROOF, ACID PROOF

The Only Reliable Belt for Severe Conditions and Difficult Drives

RAIN OR SNOW, FROST, THAW OR DRAUGHT DO NOT AFFECT IT

THE BEST OUTDOOR BELT THE LEADING FAN DRIVER

The Teon Belt is the only belt of its kind; its basis is a specially woven fabric, the best and strongest procurable, made up without joint or seam, and cemented together under **enormous pressure.** To add to the great strength of its material, it is **metal sewed** and extra stitched—example: six ply Teon has a tensile strength of **one ton per inch of width.** The cement, a secret preparation, is the prime factor in enabling it to withstand the conditions which destroy leather, rubber, duck or other material. No ingredient used is influenced by any heat under **230° Fahrenheit;** the belt will therefore run perfectly in that temperature. **Teon will not stretch,** every belt having been passed through the most powerful stretching machinery in the world. It has a fine driving surface which renders **slip rare** and easily remedied. Scientific tests have shown its ability to withstand steam, water, acid, ammonia, caustic soda, lime and other chemicals. These tests, with the names of the persons who made them, and testimonials from some of the largest firms will be cheerfully furnished, with samples, prices, and complete information. **All belts are sold with a guarantee that the claims above are correct or money refunded.**

D. P. BROWN & CO.

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262-264 North Fourth Street PHILADELPHIA, PA.

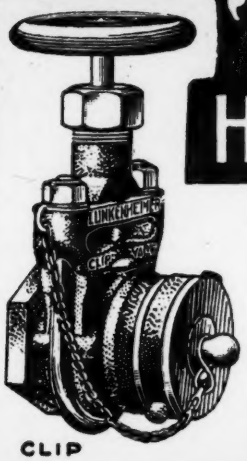
OIL PROOF RING PACKING WITH IMPORTED COMPOUND CUSHION AND SPECIAL METALLIC PROTECTION

IMPORTED OIL PROOF NON-VULCANIZING SHEET PACKING

The Lunkenheimer

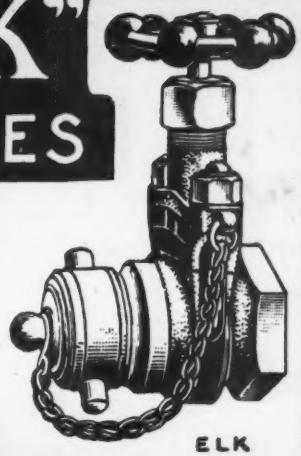
"CLIP" and "ELK"

HOSE GATE VALVES



CLIP

The "Clip" is made of iron, all bearing parts of gun metal. The "Elk" is made entirely of brass. Sizes, ¼ to 3 inches. Fulfill all Underwriters' Association requirements. Are unequaled for all ordinary pressures. Specify them and order from your dealer. Write for catalogue of Brass and Iron Engineering Appliances of superior quality.



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The LUNKENHEIMER CO.

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Engineers are invited to call and inspect a full line of our goods.

NONPAREIL CORK

STEAM, BRINE AND AMMONIA COVERING

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Sheet Cork for Cold Storage Insulation

Cork Cement for all Irregular Surfaces
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'96 Jenkins Standard '96 Packing '96

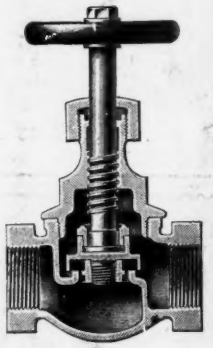
The Perfection of Joint Packing. Do not accept unless it bears our Trade-Mark as shown in the cut.

Use Jenkins '96 Sheet Packing on the worst joint you have, and if it is not what we claim we will refund the money.

JENKINS '96 PACKING has stood the most crucial tests under all conditions of service with steam, oils, acids, ammonia and the like, and in no case has it failed to make a perfect joint when properly applied. Can be placed in a joint either hot or cold, and will make joint instantly. Full steam pressure can be turned on at once when joint is made, it does not require to be followed up and will not blow out. It vulcanizes in place and forms a compound that will not rot or burn out, but will last as long as the metals which hold it. It joins with rough surfaces equally as well as when they are faced. **Jenkins Standard '96 Packing** weighs less than most joint packings. When compared with equal sizes of other packings sold at a lower price per pound, it will be found to cost less per square yard.

Jenkins Brothers' Valves

Designs, workmanship and materials of the highest standard throughout. Every valve inspected and tested before leaving the factory. Made in all styles and sizes, both brass and iron.



Jenkins Discs

Do not be deceived when you are offered discs "just as good" or better than the Jenkins, as many worthless imitations of our discs are on the market. We are the original manufacturers of this class of goods, and we have tried to maintain the high standard in which they are held by steam users throughout the world. Copper, Lead, Babbitt and all kinds of metal discs have been experimented with for the past twenty years, and in almost every instance, when under the action of steam, they become oxidized and hard, so that chip or scale getting between the disc and seat causes a leak, which necessitates regrinding. Insist on having the genuine Jenkins Discs; the difference in cost will not pay you to experiment. If you wish discs for any particular purpose, write to us; we can experiment cheaper for you than you can for yourselves. **Jenkins Discs will stand steam, oils or acids. We have special soft discs for cold water.**

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Adapted to every pumping requirement, these valves are especially suited for pumping hot water, syrups, beer and other destructive fluids; also muddy and gritty water. When rubber valves have been found useless, these valves have given entire satisfaction.

For mining and high-pressure service, also for elevator pumps, Jenkins Brothers' No. 88 Pump Valves are in use under 450 pounds pressure, and are proving themselves equal to every requirement.

We also manufacture a fine grade of Soft Rubber Valves for cold water and air service.

When ordering valves please state for what purpose you desire to use them.

Jenkins Brothers' Valves, Jenkins '96 Packing and Rubber Specialties received the highest Awards at the Pan-American Exposition

All the different specialties are stamped with Trade Mark.

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